

Annex C. Epidemiology Studies

Table C-1. Studies of CO exposure and cardiovascular morbidity.

Study	Design	Concentrations	CO Effect Estimates (95% CI)
CHANGES IN HEART RATE AND HEART RATE VARIABILITY			
Author: Chan et al. (2005, 088988)	Health Outcome: Various measures of HRV via ambulatory ECG (Holter system)	Averaging Time: 1-h ma	Increment: NR RR Estimate [Lower CI, Upper CI]
Period of Study: December 2001–February 2002	Study Design: Panel	Mean (SD) unit: 1.1 ppm	Lags examined (-h ma): 1, 2, 3, 4, 5, 6, 7, 8
Location: Taipei, Taiwan	Statistical Analyses: Linear regression (mixed effects)	Range (Min, Max): 0.1, 7.7	CO had no statistically significant effect on SDNN, rMSSD, LF, HF.
	Age Groups Analyzed: 40–75 yr	Copollutant: NR	
	Sample Description: 83 patients from the National Taiwan University Hospital		
Author: Chuang (2008, 155731)	Health Outcome: HRV (changes in ST-segment)	Averaging Time: 12 h, 24 h	Increment: NR
Period of Study: NR	Study Design: Panel	Mean (SD) unit: 12 h: 0.48 ppm, 24 h: 0.46 ppm	RR Estimate [Lower CI, Upper CI]
Location: Boston, MA	Statistical Analyses: Linear additive models; Additive mixed logistic regression models	Range (Min, Max): 12-h: 25th percentile- 0.35, 75th percentile- 0.62, Max- 1.88; 24 h: 25th percentile- 0.37, 75th percentile- 0.62, Max- 1.56	Lags examined: NR Estimated RR for ST-segment depression ≥0.1 mm (ppm): 12-h: 0.70 (0.58–0.84) 24 h: 0.84 (0.68–1.03)
	Age Groups Analyzed: 43–75	Copollutant: NR	Estimated ST-segment change, mm (ppm): 12-h mean: 0.013 (0.003–0.024) 24 h mean: 0.007 (−0.004–0.019)
	Sample Description: 48 patients with documented CAD who had undergone percutaneous coronary intervention for acute coronary syndrome (acute MI or unstable angina pectoris) or who had worsened CAD		CO not significantly associated with ST-segment depression.
Author: Dales et al. (2004, 099036)	Health Outcome: Various measures of HRV via Holter system	Averaging Time: 24 h	Increment: NR
Period of Study: NR	Study Design: Panel	Mean (SD) unit: 2.40 ppm (95th percentile)	Regression co-efficient [Lower CI, Upper CI]
Location: Toronto, Canada.	Statistical Analyses: Linear regression (mixed effects)	Personal monitoring	Lags examined: NR
	Age Groups Analyzed: 51–88 yr (mean 65 yr)	Range (Min, Max): 0.4, 16.5	CO had no statistically significant effect on LF, HF, HFLFR, SDNN among those taking beta-blockers, whereas CO had a positive effect on SDNN among those not taking beta-blockers. Slope = 0.0111 (0.002–0.020, p = 0.02)
	Sample Description: 36 subjects with pre-existing CAD	Copollutant: correlation PM _{2.5} ; r = 0.17	

Note: Hyperlinks to the reference citations throughout this document will take you to the NCEA HERO database (Health and Environmental Research Online) at <http://epa.gov/hero>. HERO is a database of scientific literature used by U.S. EPA in the process of developing science assessments such as the Integrated Science Assessments (ISAs) and the Integrated Risk Information System (IRIS).

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Gold et al. (2000, 011432) Period of Study: June-September 1997 Location: Boston, MA	Health Outcome (ICD9 or ICD10): Heart rate and various measures of HRV via Holter system Study Design: Panel/Cohort Statistical Analyses: Linear regression (fixed effects/random effects) Age Groups Analyzed: 53-87 yr Sample Description: 21 active Boston residents observed up to 12 times.	Averaging Time: 24 h Mean (SD) unit: 0.47 ppm Range (Min, Max): 0.12, 0.82 Copollutant: NR	Increment: 0.6 ppm % Change [Lower CI, Upper CI] Lags examined: 24 h No significant effect with CO (no results recorded)
Author: Gold et al. (2005, 087558) Period of Study: June-September 1999 Location: Boston, MA	Health Outcome: ST- segment. Study Design: Panel Statistical Analyses: Linear regression (mixed models) Age Groups Analyzed: 61-88 yr Sample Description: 24 active Boston residents each observed up to 12 times.	Averaging Time: 1 h, 24 h Mean (SD) unit: NR Range (Min, Max): (ppm) (personal monitoring) 10th = 0.20 90th = 1.08 Copollutant: NR	Increment: NR RR Estimate [Lower CI, Upper CI] Lags examined: 1 24 h Although CO was associated with ST-segment depression in single pollutant models, this result did not persist in multiple pollutant models.
Author: Goldberg et al. (2008, 180380) Period of Study: July 2002-October 2003 Location: Montreal, Quebec	Health Outcome: Oxygen saturation and heart rate Study Design: Panel Statistical Analyses: Mixed regression models Age Groups Analyzed: 50-85 yr Sample Description: 31 subjects with CHF and limits in physical functioning in the Heart Failure and Heart Transplant Center at the McGill University Health Center	Averaging Time: 24 h Mean (SD) unit: NR Range (Min, Max): NR Copollutant: PM _{2.5} : r = 0.72 NO ₂ : r = 0.84 SO ₂ and NO ₂ : r = 0.43	Increment: NR Adjusted Mean Difference [Lower CI, Upper CI] Lags examined: 0, 1, 2 Oxygen Saturation: Lag 0: 0.004 ppm (-0.060, 0.067) Lag 1: -0.001 ppm (-0.066, 0.065) 3-day: -0.005 ppm (-0.098, 0.088) Pulse Rate: Lag 0: 0.011 ppm (-0.290, 0.312) Lag 1: 0.227 ppm (-0.080, 0.535) 3-day: 0.245 ppm (-0.209, 0.700)
Author: Holguin et al. (2003, 057326) Period of Study: February-April 2000 Location: Mexico City, Mexico	Health Outcome: Various measures of HRV via ECG Study Design: Panel Statistical Analyses: GEE Age Groups Analyzed: 60-96 yr (mean age 79 yr) Sample Description: 34 patients who were permanent residents of a nursing home in the Northeast metropolitan area.	Averaging Time: 24 h Mean (SD) unit: 3.3 ppm Range (Min, Max): 1.8, 4.8 Copollutant: NR	Increment: 10 ppm Regression Coefficients [Lower CI, Upper CI] Lags examined: 0 Lag 0: HF: 0.003 (-0.004 to 0.001) LF: 0.001 (-0.006 to 0.008) LF/HF: 0.001 (-0.005 to 0.002)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Ibalid-Mulli et al. (2004, 087415)	Health Outcome: BP and HR via ECG Study Design: Panel Statistical Analyses: Linear regression Age Groups Analyzed: ≥ 50 yr	Averaging Time: 24 h Mean (SD) unit: Amsterdam: 0.6 mg/m ³ Erfurt: 0.4 mg/m ³ Helsinki: 0.4 mg/m ³	Increment: NR RR Estimate [Lower CI, Upper CI] Lags examined: 0, 1, 2, 3 Results presented graphically
Period of Study: 1998-1999	Location: Helsinki, Finland Erfurt, Germany Amsterdam, Netherlands	Sample Description: 131 nonsmokers with coronary heart disease	
		Range (Min, Max): Amsterdam: 0.4, 1.6 Erfurt: 0.1, 2.5 Helsinki: 0.1, 1.0	
		Copollutant: Amsterdam PM _{2.5} : r = 0.58 µg/m ³ NO ₂ : r = 0.76 µg/m ³ SO ₂ : r = 0.50 mg/m ³ UFP: r = 0.22 n/cm ³ ACP: r = 0.60 n/cm ³ Erfurt PM _{2.5} : r = 0.77 µg/m ³ NO ₂ : r = 0.86 µg/m ³ SO ₂ : r = 0.68 mg/m ³ UFP: r = 0.72 n/cm ³ ACP: r = 0.78 n/cm ³ Helsinki PM _{2.5} : r = 0.40 µg/m ³ NO ₂ : r = 0.32 µg/m ³ SO ₂ : r = 0.19 mg/m ³ UFP: r = 0.35 n/cm ³ ACP: r = 0.51 n/cm ³	
Author: Liao et al. (2004, 056590)	Health Outcome: Heart rate & various rates of HRV. Study Design: Cohort Statistical Analyses: Linear regression	Averaging Time: 24 h Mean (SD) unit: 0.65 ppm (0.44)	Increment: 0.44 ppm Regression coefficients Lags examined: 1
Period of Study: 1996-1998	Location: Forsyth County, NC; Selected suburbs of Minneapolis, MN; Jackson, MI	Age Groups Analyzed: 45-64 yr (mean 62 yr) Sample Description: 6,784 study subjects from the atherosclerosis risk in communities study	Range (Min, Max): NR Copollutant: NR Lag 1: HF (log transformed): -0.033 LF (log transformed): 0.006 SDNN: -0.274 Heart Rate (bpm): 0.404* Confidence Intervals: not recorded
			*p < 0.05

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Min (2009, 199514) Period of Study: December 2003 – January 2004 Location: Tae-in island community in South Korea	Health Outcome: HRV Study Design: Panel Statistical Analyses: Time-lag model Age Groups Analyzed: 20-87 Sample Description: 986 subjects, 367 with metabolic syndrome (MetS), 619 without MetS	Averaging Time: 8 h Mean (SD) unit: 0.454 ppm (0.560) Range (Min, Max): 0.100, 7.200 ppm Copollutant: PM ₁₀	Increment: NR Estimated % Increase in subjects with MetS [Lower CI, Upper CI] Lags examined: 0-1, 1-2, 2-3, 3-4, 4-5, 5-6 Single pollutant: Lag 0-1: Log(SDNN): -0.29 (-0.59, 0.00), p < 0.1 Log(LF): -0.34 (-1.02, 0.33) Log(HF): -0.67 (-1.41, 0.08), p < 0.1 Lag 1-2: Log(SDNN): -0.45 (-0.81, -0.10), p < 0.05 Log(LF): -0.65 (-1.46, 0.17) Log(HF): -1.04 (-1.94, -0.14), p < 0.05 Lag 2-3: Log(SDNN): -0.28 (-0.57, 0.02), p < 0.1 Log(LF): -0.19 (-0.87, 0.48) Log(HF): -0.82 (-1.57, -0.07), p < 0.05 Lag 3-4: Log(SDNN): -0.18 (-0.47, 0.10) Log(LF): -0.14 (-0.80, 0.51) Log(HF): -0.46 (-1.19, 0.27) Lag 4-5: Log(SDNN): -0.20 (-0.49, 0.09) Log(LF): -0.36 (-1.04, 0.31) Log(HF): -0.42 (-1.17, 0.33) Lag 5-6: Log(SDNN): 0.13 (-0.18, 0.44) Log(LF): 0.50 (-0.21, 1.20) Log(HF): -0.03 (-0.81, 0.76) Co-pollutant (with PM ₁₀): Lag 0-1: Log(SDNN): -0.25 (-0.56, 0.05) Log(LF): -0.35 (-1.04, 0.31) Log(HF): -0.67 (-1.44, 0.10), p<0.1 Lag 1-2: Log(SDNN): -0.48 (-0.88, -0.09), p<0.05; Log(LF): -0.72 (-1.63, 0.18); Log(HF): -1.09 (-2.09, -0.09), p<0.05 Lag 2-3: Log(SDNN): -0.35 (-0.67, -0.03), p < 0.05 Log(LF): -0.17 (-0.90, 0.56) Log(HF): -0.78 (-1.59, 0.03), p < 0.1 Lag 3-4: Log(SDNN): -0.22 (-0.55, 0.11) Log(LF): -0.11 (-0.86, 0.63) Log(HF): -0.34 (-1.17, 0.49) Lag 4-5: Log(SDNN): -0.18 (-0.48, 0.12); Log(LF): -0.21 (-0.89, 0.48); Log(HF): -0.37 (-1.14, 0.40) Lag 5-6: Log(SDNN): 0.17 (-0.14, 0.49) Log(LF): 0.54 (-0.18, 1.25) Log(HF): 0.00 (-0.80, 0.80)
			No significant results for subjects without MetS.

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Park et al. (2005, 057331) Period of Study: 2000-2003 Location: Boston, MA	Health Outcome: Various measures of HRV via ECG Study Design: Panel/Cohort Statistical Analyses: Linear regression Age Groups Analyzed: 21-81 yr Sample Description: 497 men from the normative aging study in Greater Boston area	Averaging Time: 24 h Mean (SD) unit: 0.50 ppm Range (Min, Max): 0.13, 1.8 Copollutant: NR	Increment: 0.24 ppm % Change in HRV [Lower CI, Upper CI] Lags examined: 4-h ma, 24-h ma, 48-h ma Lag 4-h ma: SDNN (Log10): 2.0 (-2.9 to 7.3) HF (Log10): 8.8 (-4.6 to 24.1) LF(Log10): 3.2 (-7.0 to 14.6) LF:HF(Log10): -5.1 (-13.5 to 4.1) Lag 24-h ma: SDNN (Log10): -2.2 (-7.7 to 3.6) HF (Log10): -13.2 (-25.4 to 1.0) LF(Log10): -0.6 (-11.9 to 12.1) LF:HF(Log10): 14.5 (2.9-27.5) Lag 48-h ma: SDNN(Log10): -3.4 (-10.2 to 3.9) HF (Log10): -13.8 (-28.9 to 4.4) LF (Log10): -2.4 (-16.2 to 13.6) LF:HF (Log10): 13.2 (-1.1 to 29.6)
Author: Peters et al. (1999, 011554) Period of Study: 1984-1985 Location: Augsburg, Germany	Health Outcome: Heart rate Study Design: Cohort Statistical Analyses: Linear regression (GEE) Age Groups Analyzed: 25-64 yr Sample Description: 2681 men and women who participated in the MONICA study	Averaging Time: 24 h Mean (SD) unit: During air pollution episode: 4.54 mg/m ³ Outside air pollution episode: 4.51 mg/m ³ Range (Min, Max): During air pollution episode: 2.39, 6.85 Outside air pollution episode: 0.91, 11.51 Copollutant: NR	Increment: 6.6 mg/m ³ Mean Change in Heart Rate (beats/min) [Lower CI, Upper CI] Lags examined: 0, 5-day avg All Lag 0: 0.97 (0.02-1.91) Lag 5-day avg: 0.70 (-0.09 to 1.48) Men Lag 0: 0.95 (-0.37 to 2.27) Lag 5-day avg: 0.91 (-0.25 to 2.07) Women Lag 0: 0.98 (-0.37 to 2.34) Lag 5-day avg: 0.52 (-0.55 to 1.59)
Author: Riojas-Rodriguez et al. (2006, 156913) Period of Study: December 2001-April 2002 Location: Mexico City, Mexico	Health Outcome: Various measures of HRV via Holter system Study Design: Panel Statistical Analyses: Linear regression (mixed effects models) Age Groups Analyzed: 25-76 yr (mean 55 yr) Sample Description: 30 patients from the Outpatient Clinic of the National Institute of Cardiology of Mexico	Averaging Time: 24 h Mean (SD) unit: 2.9 ppm (personal monitor) Range (Min, Max): 0.1, 18.0 Copollutant: NR	Increment: 1 ppm Regression Coefficients [Lower CI, Upper CI] Lags examined (per min): 5, 10 Lag 5 min: HF: -0.006 (-0.023 to 0.010) LF: -0.024 (-0.041 to -0.007) VLF: -0.034 (-0.061 to -0.007) Notes: VLF = Very low frequency
Author: Schwartz et al. (2005, 074317) Period of Study: 1999 Location: Boston, MA	Health Outcome: Measures of HRV via Holter system Study Design: Panel Statistical Analyses: Linear regression (hierarchical model) Age Groups Analyzed: 61-89 yr Sample Description: 28 subjects living at or near an apartment complex located on the same street as the Harvard School of Public Health	Averaging Time: 24 h Mean (SD) unit: NR Range (Min, Max): ppm 25th = 0.38; 75th = 0.54 Copollutant: correlation PM _{2.5} : r = 0.61 NO ₂ : r = 0.55 SO ₂ : r = -0.18 O ₃ : r = 0.21	Increment: 0.16 ppm % Change in HRV [Lower CI, Upper CI] Lags examined: 24 h, 1 h Lag 1 h: SDNN: -2.6 (-5.6 to 0.5); rMSSD: -3.9 (-10.6 to 3.3); PNN50: -3.5 (-13.7 to 8.0); LF:HF: 4.5 (-1.2 to 10.5) Lag 24 h: SDNN: -4.2 (-0.6 to -7.7); rMSSD: -10.2 (-2.4 to -17.4); PNN50: -14.8 (-3.0 to -25.2); LF:HF: 6.2 (-0.6 to 13.4)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Tarkiainen et al. (2003, 053625) Period of Study: October 1997-May 1998 Location: Kuopio, Finland	Health Outcome: Various measures of HRV via Ambulatory ECG (Holter system) Study Design: Panel Statistical Analyses: ANOVA for repeated errors (GLM) Age Groups Analyzed: 55-68 yr Sample Description: 6 male patients with angiographically- verified CAD	Averaging Time: 24 h Mean (SD) unit: 4.6 ppm (max of CO episode) (personal monitoring) Range (Min, Max): 0.5, 27.4 (max of CO episode) Copollutant: NR	Increment: NR RR Estimate [Lower CI, Upper CI] Lags examined: 5 min prior to CO episode, 5 min during CO episode CO had no statically significant effect on NN, SDNN or rMSSD. However, during high CO exposure (>2.7 ppm), CO was associated with an increase in rMSSD of 2.4ms (p=0.034).
Author: Timonen et al. (2006, 088747) Period of Study: 1998-1999 Location: 3 Cities in Europe: Amsterdam, Netherlands; Erfert, Germany; Helsinki, Finland	Health Outcome: Stable CAD: Various measures of HRV via ambulatory ECG (Holter system) Study Design: Panel Statistical Analyses: Linear regression (mixed model) Age Groups Analyzed: Mean age across 3 cities; 64-71 yr. Sample Description: 131 subjects with stable CAD followed for 6 mo with biweekly clinical visits.	Averaging Time: 24 h Mean (SD) unit: Amsterdam: 0.6 mg/m ³ Erfert: 0.4 mg/m ³ Helsinki: 0.4 mg/m ³ Range (Min, Max): Amsterdam: 0.4, 1.6 Erfert: 0.1, 2.5 Helsinki: 0.1, 1.0 Copollutant: correlation Amsterdam: $PM_{2.5}$: r = 0.58 NO_2 : r = 0.76 Erfert: PM_{10} : r = 0.77 NO_2 : r = 0.86 Helsinki: PM_{10} : r = 0.40 NO_2 : r = 0.32	Increment: 1 mg/m ³ Regression co-efficient [Lower CI, Upper CI] Lags examined (days): 0, 1, 2, 3, 5-day avg SDNN: Lag 0: -1.21 (-4.44 to 2.03); Lag 1: -1.71 (-6.05 to 2.63); Lag 2: -5.69 (-10.7 to -0.72); Lag 3: 0.66 (-3.83 to 5.15); 5-day avg: -3.60 (-9.88 to 2.68) HF: Lag 0: 5.0 (-15.1 to 25.1); Lag 1: -2.0 (-37.1 to 33.1); Lag 2: -30.7 (-59.8 to -1.5); Lag 3: -9.3 (-35.8 to -17.3); 5-day avg: -15.2 (-53.0 to 22.6) LF/HF: Lag 0: -3.6 (-21.8 to 14.5); Lag 1: -28.6 (-52.0 to -5.3); Lag 2: -10.1 (-36.9 to 16.7); Lag 3: 7.7 (-16.5 to 31.9); 5-day avg: -16.9 (-51.2 to 17.3)
Author: Wheeler et al. (2006, 088453) Period of Study: 1999-2000 Location: Atlanta, GA	Health Outcome: Various measures of HRV via Holter system Study Design: Panel Statistical Analyses: Linear regression (mixed effects models) Age Groups Analyzed: Mean 65 yr; IQR 55-73 yr Sample Description: 18 subjects with COPD and 12 subjects with recent MI.	Averaging Time: 1 h Mean (SD) unit: 362.0 ppb Range (Min, Max): 25th = 221.5; 75th = 398.1 Copollutant: correlation $PM_{2.5}$: r = 0.43	Increment: NR RR Estimate [Lower CI, Upper CI] ; lag: Lags examined (h ma): 1, 4, 24 No CO results reported.

Study	Design	Concentrations	CO Effect Estimates (95% CI)
ONSET OF CARDIAC ARRHYTHMIA			
Author: Berger et al. (2006, 098702)	Health Outcome: Runs of supraventricular and ventricular tachycardia recorded via 24-h ECG.	Averaging Time: 24 h Mean (SD) unit: 0.52 mg/m ³	Increment: All: 0.27 mg/m ³
Period of Study: October 2000-April 2001	Study Design: Panel	Range (Min, Max): 0.11, 1.93	5-day avg: 0.22 mg/m ³
Location: Erfurt, Germany	Statistical Analyses: Poisson regression (GAM) linear regression	Copollutant: correlation NR	RR Estimate [Lower CI, Upper CI]
	Age Groups Analyzed: 52-76 yr (mean 76 yr)		Lags examined (h): 0, 0-23, 24-47, 48-71, 72-95, 5-day avg
	Sample Description: 57 men with CHD		Supraventricular extrasystoles: Lag 0: 1.18 (1.00-1.38) Lag 0-23: 1.16 (1.02-1.31); Lag 24-47: 1.13 (1.00-1.28); Lag 48-71: 1.18 (1.03-1.36); Lag 72-95: 1.08 (0.98-1.20); 5-day avg: 1.18 (1.04-1.35)
			Mean % Change [Lower CI, Upper CI]
			Hourly Lags examined: 0, 0-23, 24-47, 48-71, 72-95, 5-day avg
			Ventricular extrasystoles: Lag 0: 0.0 (-4.1 to 4.4); Lag 0-23: 1.1 (-3.3 to 5.7); Lag 24-47: 1.9 (-2.6 to 6.6); Lag 48-71: 4.2 (-0.3 to 8.9); Lag 72-95: 2.7 (-1.3 to 6.9); 5-day avg: 3.0 (-1.8 to 8.0)
Author: Dockery et al. (2005, 078995)	Health Outcome: Tachyarrhythmias:	Averaging Time: 24 h	Increment: 0.48 ppm
Period of Study: 1995-2002	Study Design: Panel	Mean (SD) unit: NR	OR for Ventricular Arrhythmia [Lower CI, Upper CI]
Location: Boston, MA	Statistical Analyses: Logistic regression (GEE)	Range (Min, Max): 25th = 0.53; 75th = 1.02	Lags examined (days): 0, 1, 2, 3
	Age Groups Analyzed: 19-90 yr; mean 64 yr	Copollutant: NR	Lag 2-day ma: 1.14 (0.95-1.29)
	Sample Description: 203 cardiac patients with ICDs within 40km of air monitoring site at Harvard School of Public Health, Boston		Among those who had an arrhythmia: within 3 days: 1.65 (1.17-2.33) later than 3 days: 1.04 (0.83-1.29)
Author: Metzger et al. (2007, 092856)	Health Outcome: Cardiac arrhythmia, ICD, ventricular tachyarrhythmia	Averaging Time: 1 h	Increment: 1 ppm
Period of Study: 1993-2002	Study Design: Panel	Mean (SD) unit: 1.7 ppm	OR for Tachyarrhythmic event [Lower CI, Upper CI]
Location: Atlanta, GA	Statistical Analyses: Logistic regression (GEE)	Range (Min, Max): 0.1, 7.7	Lags examined (days): 0
	Age Groups Analyzed: 15-88 yr	Copollutant: NR	Results for all events Lag 0: 0.999 (0.970-1.028)
	Sample Description: 518 patients with ICDs with at least one ventricular tachyarrhythmic event		Events resulting in cardiac pacing or defibrillation Lag 0: 1.008 (0.964-1.054)
			Events resulting defibrillation Lag 0: 1.012 (0.925-1.10.7)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Peters et al. (2000, 011347)	Health Outcome: Defibrillated discharges for ventricular tachycardia or fibrillation	Averaging Time: 24 h Mean (SD) unit: 0.58 ppm	Increment: 0.65 ppm (Lags 0, 1, 2, 3); 0.42 ppm (Lag 5-day mean)
Period of Study: 1995-1997	Study Design: Panel	Range (Min, Max): 25th = 0.43; 75th = 0.66	OR for Defibrillated Discharge [Lower CI, Upper CI]
Location: Eastern Massachusetts	Statistical Analyses: Conditional logistic regression	Copollutant: correlation	Lags examined (days): 0, 1, 2, 3, 5-day mean
	Age Groups Analyzed: Mean 62 yr	PM ₁₀ : r = 0.51 PM _{2.5} : r = 0.56 NO ₂ : r = 0.71 SO ₂ : r = 0.41 O ₃ : r = -0.40	At least one discharge: Lag 0: 1.07 (0.62-1.86); Lag 1: 1.06 (0.61-1.85); Lag 2: 1.05 (0.62-1.77); Lag 3: 0.09 (0.65-1.83); Lag 5-day mean: 1.23 (0.71-2.12) At least 10 discharges: Lag 0: 1.12 (0.54-2.32); Lag 1: 1.13 (0.54-2.33); Lag 2: 1.62 (0.85-3.09); Lag 3: 1.98 (1.05-3.72); Lag 5-day mean: 1.94 (1.01-7.75)
Author: Rich et al. (2004, 055631)	Health Outcome: Cardiac arrhythmia via patients ICD	Averaging Time: 24 h	Increment: NR
Period of Study: February-December 2000	Study Design: Case crossover	Mean (SD) unit: 553.8 ppb	RR Estimate [Lower CI, Upper CI]
Location: Vancouver, Canada	Statistical Analyses: Conditional logistic regression	Range (Min, Max): IQR: 162.7	Lags examined (days): 0, 1, 2, 3
	Age Groups Analyzed: 15-85 yr	Copollutant: correlation	No significant effect (results not reported in table).
	Sample Description: 34 patients who experienced at least 1 ICD discharge (8,201 person days)	PM ₁₀ : r = 0.40 SO ₂ : r = 0.75 NO ₂ : r = 0.68 O ₃ : r = -0.56	
Author: Rich et al. (2005, 079620)	Health Outcome: Ventricular arrhythmias via ICD	Averaging Time: 1 h and 24 h	Increment: 0.56 ppm; 0.54; 0.51; 0.49 respectively for results shown below
Period of Study: 1995-1999	Study Design: Panel/Case crossover	Mean (SD) unit: NR	OR Estimate [Lower CI, Upper CI]
Location: Boston, MA	Statistical Analyses: Conditional logistic regression	Range (percentiles): 1 h: 25th = 0.46 75th = 1.04	Ventricular arrhythmia
	Age Groups Analyzed: All	24 h: 25th = 0.52 75th = 1.03	Hours prior to event: 0-2: 1.01 (0.87-1.18) 0-6: 1.00 (0.85-1.17) 0-23: 1.03 (0.84-1.25) 0-47: 1.11 (0.88-1.40)
	Sample Description: 203 patients with implanted ICD at the New England Medical Center	Copollutant: NR	
Author: Rich et al. (2006, 089814)	Health Outcome: Ventricular arrhythmia	Averaging Time: 24 h	Increment: 0.2 ppm
Period of Study: 2001 & 2002	Study Design: Case crossover	Mean (SD) unit: NR	OR for Ventricular Arrhythmia [Lower CI, Upper CI]
Location: St. Louis, MO	Statistical Analyses: Conditional logistic regression	Range (Min, Max): 25th = 0.4; 75th = 0.6	Lags examined: 0 to 23-h ma: 0- to 23-h ma: 0.99 (0.80-1.21)
	Age Groups Analyzed: All	Copollutant: NR	
	Sample Description: 60 subjects with at least 1 ICD recorded arrhythmia who lived within 40 km of St. Louis – Midwest supersite.		

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Rich et al. (2006, 088427)	Health Outcome: ICD episode of atrial fibrillation	Averaging Time: 1 h and 24 h	Increment: Lag (hrs) 0: 0.58 ppm
Period of Study: 1995-1999	Study Design: Panel/case crossover	Mean (SD) unit: NR	Lag (hrs) 0-23: 0.51 ppm
Location: Boston, MA	Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All Sample Description: 203 patients with ICDs at the New England Medical Center	Range (Min, Max): 1 h: 25th = 0.46; 75th = 1.04 24 h: 25th = 0.52; 75th = 1.03 Copollutant: NR	OR for episode of atrial fibrillation [Lower CI, Upper CI] Lags (h): 0, 0-23 Lag 0: 0.87 (0.56-1.37) Lag 0-23: 0.71 (0.39-1.28)
Author: Sari et al. (2008, 190315)	Health Outcome: P-wave dispersion (predictors of atrial fibrillation, ventricular arrhythmias and sudden death) via ECG	Averaging Time: NR	Increment: NR
Period of Study: June 2007	Study Design: Case control	Mean (SD) unit: COHb%	Correlation coefficient for COHb [p-value]
Location: Gaziantep, Turkey	Statistical Analyses: Pearson correlation analysis Age Groups Analyzed: Barbecue workers mean age: 33.66 ± 9.43 yr Control group mean age: 35.15 ± 6.78 yr Sample Description: 48 healthy males working at various indoor barbecue restaurants for at least 3 yr (avg: 15.6 ± 7.1 yr), 51 age-matched healthy men for control group	Indoor barbecue workers: $6.48\% \pm 1.43$ Control Group: $2.19\% \pm 1.30$ Range (Min, Max): NR Copollutant: NR	Lags examined: NR Pmin: -0.132 (0.245) Pmax: 0.215 (0.057) Pd: 0.315 (0.005) QTmin: 0.080 (0.454) QTmax: 0.402 (<0.001) QTd: 0.573 (<0.001) cQTd: 0.615 (<0.001)
Author: Sarnat et al. (2006, 090489)	Health Outcome: Arrhythmia via ECG measurements	Averaging Time: 24 h	Increment: 0.2 ppm
Period of Study: 24 wk during the summer and fall of 2000	Study Design: Panel	Mean (SD) unit: 0.02 ppm	RR Estimate [Lower CI, Upper CI] ; lag:
Location: Steubenville, OH	Statistical Analyses: Logistic regression Age Groups Analyzed: 53-90 yr (mean age 71) Sample Description: 32 nonsmoking older adults	Range (Min, Max): -0.1, 1.5 Copollutant: correlation $PM_{2.5}$: r = 0.45 SO_2 : r = 0.62 NO_2 : r = 0.66 O_3 : r = -0.37	Lags examined (days): 1, 2, 3, 4, 5, 5-day ma Lag 5-day ma: Supraventricular ectopy SVE: 0.99 (0.76-1.29) Ventricular ectopy VE: 1.05 (0.75-1.46)
Author: Vedral et al. (2004, 055630)	Health Outcome: Cardiac arrhythmia via patients with ICD	Averaging Time: 24 h	Increment: 0.2 ppm
Period of Study: 1997-2000	Study Design: Panel	Mean (SD) unit: 0.6 ppm	RR Estimate [Lower CI, Upper CI]
Location: Vancouver, Canada	Statistical Analyses: Logistic regression (GEE) Age Groups Analyzed: Range from 12-77 yr (mean age 53 yr) Sample Description: 50 patients who experienced 1 or more arrhythmia event during the 4yr	Range (Min, Max): 0.3, 1.6 Copollutant: correlation PM_{10} : r = 0.43 SO_2 : r = 0.62 NO_2 : r = 0.74 O_3 : r = -0.52	Lags examined (days): 0, 1, 2, 3 No significant effect for CO (results shown in plots)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
CARDIAC ARREST			
Author: Levy et al. (2001, 017171)	Health Outcome: Out-of-hospital primary cardiac arrest	Averaging Time: 24 h Mean (SD) unit: 1.79 ppm	Increment: NR RR Estimate [Lower CI, Upper CI]
Period of Study: 1988-1994	Study Design: Case crossover	Range (Min, Max): 0.52, 5.92	Lags examined (days): 0, 1
Location: Seattle, WA	Statistical Analyses: Conditional logistic regression	Copollutant: correlation	Lag 1: 0.99 (0.83-1.18)
	Age Groups Analyzed: 25-75 yr	PM_{10} : r = 0.81 SO_2 : r = 0.29	
	Sample Description: 362 cases		
Author: Sullivan et al. (2003, 043156)	Health Outcome: Out-of-Hospital cardiac arrest	Averaging Time: 24 h Mean (SD) unit: 1.92 ppm	Increment: 1.02 ppm OR Estimate [Lower CI, Upper CI]
Period of Study: 1985-1994	Study Design: Case crossover	Range (Min, Max): 0.52, 7.21	Lags examined (days): 0, 1, 2
Location: Washington State	Statistical Analyses: Conditional logistic regression	Copollutant: NR	Lag 0: 0.95 (0.85-1.05) Lag 1: 0.97 (0.87-1.08) Lag 2: 0.99 (0.89-1.11)
	Age Groups Analyzed: All		
	Sample Description: 1,542 members of a large health maintenance organization		
MYOCARDIAL INFARCTION			
Author: Peters et al. (2001, 016546)	Health Outcome: Onset of MI	Averaging Time: 24 h	Increment: 2 H-1 ppm; 24 h – 0.6 ppm
Period of Study: 1995-1996	Study Design: Case crossover	Mean (SD) unit: 1.09	OR Estimate [Lower CI, Upper CI]
Location: Boston, MA	Statistical Analyses: Conditional logistic regression	Range (percentiles): ppm 5th = 0.49 95th = 1.78	Onset of MI: 2-h prior: 1.22 (0.89-1.67) 24 h prior: 0.98 (0.70-1.36)
	Age Groups Analyzed: All	Copollutant: NR	
	Sample Description: 772 participants		
Author: Rosenlund et al. (2006, 089796)	Health Outcome: MI	Averaging Time:	Increment: 300 $\mu\text{g}/\text{m}^3$
Period of Study: 1992-1994	Study Design: Case control	Mean (SD) unit: 66.8 $\mu\text{g}/\text{m}^3$ (Estimated 30-yr residential exposure)	OR Estimate [Lower CI, Upper CI] ; lag: Estimated 30-yr avg exposure
Location: Stockholm, Sweden	Statistical Analyses: Logistic regression	Range (percentiles): 5th = 13.9; 95th = 295.7	All cases: 1.04 (0.89-1.21) Nonfatal cases: 0.98 (0.82-1.16) Fatal cases: 1.22 (0.98-1.52) In-hospital death: 1.16 (0.89-1.51) Out-of-hospital death: 1.36 (1.01-1.84)
	Age Groups Analyzed: 45-70 yr	Copollutant: NR	
	Sample Description: 1,397 cases; 1,870 controls		
Author: Rosenlund et al. (2009, 190309)	Health Outcome: Fatal and nonfatal MI	Averaging Time: 1 yr	Increment: NR
Period of Study: NR	Study Design: Case control	Mean (SD) unit:	OR Estimate [Lower CI, Upper CI]
Location: Stockholm County, Sweden	Statistical Analyses: Various multiple regression models	Cases: 64.2 $\mu\text{g}/\text{m}^3$	5-yr avg exposure
	Age Groups Analyzed: 15-79 yr	Controls: 55.8 $\mu\text{g}/\text{m}^3$	All subjects (n = 301,273)
	Sample Description: 43,275 MI cases during 1985-1996; 511,065 controls	Range (percentiles): Cases: 5th = 7.3; 95th = 267.4 Controls: 5th = 6.1; 95th = 261.8	All cases: 1.01 (0.97-1.05) Nonfatal cases: 0.94 (0.89-1.00) Fatal cases: 1.14 (1.07-1.21) In-hospital death: 1.00 (0.91-1.10) Out-of-hospital death: 1.23 (1.14-1.32)
		Copollutant: PM_{10} , NO_2	Restriction to subjects who did not move between population census (n = 80,155)
			All cases: 1.04 (0.94-1.14) Nonfatal cases: 0.96 (0.87-1.06) Fatal cases: 2.03 (1.59-2.60) In-hospital death: 2.04 (1.35-3.08) Out-of-hospital death: 2.03 (1.50-2.74)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
CHANGES IN BLOOD PRESSURE			
Author: Ibalde-Mulli et al. (2001, 016030)	Health Outcome: BP–SPB Study Design: Cohort	Averaging Time: 24 h Mean (SD) unit: 4.1 mg/m ³	Increment: Lag 0: 5.6 mg/m ³ 5-day prior avg
Period of Study: 1984-1985	Statistical Analyses: Gaussian regression for repeated measures	Range (Min, Max): 1.7, 8.2	Mean Change [Lower CI, Upper CI] SPB mmHg
Location: Augsburg, Germany	Age Groups Analyzed: 25-64 yr	Copollutant: NR	Lag 0 (days): All: 0.53 (-0.66 to 1.72); Men: 0.68 (-0.94 to 2.31); Women: 0.51 (-1.31 to 2.19) 5-day prior avg: All: 1.06 (-0.17 to 2.29); Men: 0.92 (-0.87 to 2.70); Women: 0.91 (-0.87 to 2.70)
Author: Zanobetti et al. (2004, 087489)	Health Outcome: BP Study Design: Cohort/Panel	Averaging Time: 1 h and 120 h avg	Increment: NR
Period of Study: 1999-2001	Statistical Analyses: Random effects	Mean (SD) unit: Same h: 0.81 ppm 120-h avg: 0.66 ppm	RR Estimate [Lower CI, Upper CI] CO had no significant effect on BP
Location: Boston, MA	Age Groups Analyzed: 39-90 yr Sample Description: 62 subjects with 631 total visits	Range (Min, Max): Same h: 10th = 0.48; 90th = 1.22 120-h avg: 10th = 0.48; 90th = 0.86	
		Copollutant: NR	
CHANGES IN BLOOD MARKERS OF COAGULATION AND INFLAMMATION			
Author: Baccarelli et al. (2007, 090733)	Health Outcome: Prothrombin time (PT) and activated partial thromboplastin time (APTT)	Averaging Time: 1 h	Increment: NR
Period of Study: 1995-2005	Study Design: Panel	Mean (SD) unit: NR	Regression co-efficient [Lower CI, Upper CI]
Location: Milan, Italy	Statistical Analyses: GAMS Age Groups Analyzed: 11-84 yr (mean 43 yr) Sample Description: 1,218 healthy individuals who were partners or friends of patients with thrombosis who attended the thrombosis center of the University of Milan.	Range (percentiles): Sept-Nov: 25th = 1.36; 75th = 3.52 Dec-Feb: 25th = 2.00; 75th = 4.31 Mar-May: 25th = 1.03; 75th = 2.14 Jun-Aug: 25th = 0.73; 75th = 1.58	Lags examined (time of blood sampling – avg): 0, 7, 30 PT: Lag 0: -0.11 (-0.18 to -0.05); Lag 7: -0.07 (-0.14 to 0.01); Lag 30: -0.05 (-0.13 to 0.02) APTT: Lag 0: 0.03 (-0.04 to 0.10); Lag 7: 0.04 (-0.04 to 0.11); Lag 30: 0.06 (-0.01 to 0.14)
		Copollutant: NR	Notes: CO had no effect on fibrinogen, functional antithrombin, functional protein C, protein C antigen, functional protein S, or free protein S for all lag periods.

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Delfino et al. (2008, 156390)	Health Outcome: Biomarkers of systemic inflammation	Averaging Time: 24 h	Increment: NR
Period of Study: 2005-2006	Study Design: Panel	Mean (SD) unit: $0.78 \pm 0.30 \text{ ppb}$	Estimated coefficient
Location: Los Angeles, CA	Statistical Analyses: Age Groups Analyzed: $\geq 65 \text{ yr}$ (mean 85.7 yr)	Range (Min, Max): 0.22, 1.97 Copollutant (Outdoor): EC: $r = 0.84$ OC: $r = 0.69$ OCprimary: $r = 0.73$ NO_2 : $r = 0.78$ O_3 : $r = -0.35$ $\text{PM}_{0.25}$: $r = 0.84$ $\text{PM}_{0.25-2.5}$: $r = 0.14$ $\text{PM}_{2.5-10}$: $r = 0.51$	Relationship to outdoor air pollutants: CRP (ng/mL): Lag 0: 847.52; 3-day avg: 728.79; 9-day avg: 236.51 IL-6 (pg/mL): Lag 0: 0.52; 3-day avg: 0.51; 9-day avg: 0.50 sTNF-RII (pg/mL): Lag 0: 154.05; 3-day avg: 139.45; 9-day avg: 225.60 Relationship to indoor air pollutants: CRP (ng/mL): Lag 0: 695.39; 3-day avg: 527.37; 9-day avg: 760.15 IL-6 (pg/mL): Lag 0: 0.54; 3-day avg: 0.47; 9-day avg: 0.77 sTNF-RII (pg/mL): Lag 0: 114.22; 3-day avg: 107.95; 9-day avg: 273.38 Relationship of sP-selection (ng/mL) to: Indoor air pollutants: Lag 0: 0.77; 5-day avg: 1.40; 9-day avg: 2.19 Outdoor air pollutants: Lag 0: 0.84; 5-day avg: 1.23; 9-day avg: 4.29 Relationship of Cu, Zn-SOD (U/g Hb) to: Indoor air pollutants: Lag 0: -145.54; 5-day avg: -238.72; 9-day avg: -70.10 Outdoor air pollutants: Lag 0: -105.73; 5-day avg: -176.72; 9-day avg: -41.92

Study	Design	Concentrations	CO Effect Estimates (95% CI)
<p>Author: Delfino et al. (2009, 200844)</p> <p>Period of Study: Jul-midOct and midOct-Feb of 2005-2006 and 2006-2007</p> <p>Location: Los Angeles, CA</p>	<p>Health Outcome: Biomarkers of inflammation</p> <p>Study Design: Panel</p> <p>Statistical Analyses: Linear mixed effects models adjusted for confounders</p> <p>Age Groups: 65+ (84.1 ± 5.60) yr</p> <p>Sample Description: 60 subjects with confirmed CAD history, nonsmoker, unexposed to environmental tobacco smoke</p>	<p>Averaging Time: 24 h</p> <p>Mean (SD) unit: 0.50 (0.25) ppm</p> <p>Range (min, max): 0.11, 1.30</p> <p>Copollutant: NO₂, NO_x, O₃, PM_{0.25}, PM_{0.25-2.5}, PM_{2.5-10}, EC₃ OC, BC, OCpri, SOC, PN/cm³</p>	<p>Increment: NR</p> <p>Regression coefficients (95% CI)</p> <p>Subjects with positive responses: Cu,Zn-SOD (U/g Hb): 1-day avg: 1441 (97, 2786), 3-day avg: 2634 (1416, 3854), 5-day avg: 4227 (2078, 6376), 7-day avg: 3474 (914, 6034), 9-day avg: 2954 (737, 5172) GPx-1 (U/g HB): 1-day avg: -0.97 (-4.45, 2.50), 3-day avg: -2.21 (-6.48, 2.06), 5-day avg: 4.71 (-2.90, 12.33), 7-day avg: 4.20 (-3.29, 11.68), 9-day avg: 4.76 (-1.58, 11.10)</p> <p>Subjects with negative responses: Cu,Zn-SOD (U/g Hb): 1-day avg: -195 (-338, -52), 3-day avg: -242 (-399, -85), 5-day avg: -242 (-440, -44), 7-day avg: -315 (-664, 34), 9-day avg: -176 (-508, 156) GPx-1 (U/g HB): 1-day avg: -0.82 (-1.55, -0.08), 3-day avg: -0.85 (-1.66, -0.04), 5-day avg: -0.84 (-1.88, 0.21), 7-day avg: -1.04 (-2.85, 0.78), 9-day avg: -0.47 (-2.19, 1.26)</p> <p>All subjects: IL-6 (pg/mL): 1-day avg.: 0.35 (0.17, 0.54), 3-day avg.: 0.40 (0.20, 0.61), 5-day avg.: 0.54 (0.27, 0.80), 7-day avg.: 0.34 (-0.06, 0.74), 9-day avg.: 0.31 (-0.07, 0.70) P-selectin (ng/mL): 1-day avg.: 3.33 (0.94, 5.73), 3-day avg.: 3.65 (1.02, 6.29), 5-day avg.: 5.28 (1.86, 8.70), 7-day avg.: 11.2 (5.39, 17.0), 9-day avg.: 10.4 (4.83, 16.0) TNF-RII (pg/mL): 1-day avg: 112 (13, 211), 3-day avg: 136 (29, 243), 5-day avg: 229 (88, 371), 7-day avg: 132 (-86, 349), 9-day avg: 220 (19, 421) TNF-α (pg/mL): 1-day avg: 0.05 (-0.05, 0.16), 3-day avg: 0.09 (-0.03, 0.20), 5-day avg: 0.14 (-0.01, 0.29), 7-day avg: 0.07 (-0.19, 0.33), 9-day avg: 0.14 (-0.11, 0.39) CRP (ng/mL): 1-day avg: 780 (343, 1217), 3-day avg: 739 (255, 1222), 5-day avg: 1117 (485, 1749), 7-day avg: 126 (-800, 1052), 9-day avg: 41 (-840, 923) SOD (U/g Hb): 1-day avg: -62 (-231, 108), 3-day avg: -53 (-244, 138), 5-day avg: -37 (-285, 211), 7-day avg: 98 (-314, 509), 9-day avg: 208 (-173, 590) GPx-1 (U/g Hb): 1-day avg: -0.69 (-1.41, 0.03), 3-day avg: -0.69 (-1.48, 0.11), 5-day avg: -0.56 (-1.60, 0.48), 7-day avg: -0.56 (-2.34, 1.21), 9-day avg: 0.05 (-1.63, 1.72)</p> <p>Effect modification by medication use: TNF-RII (pg/mL): 1-day avg: All subjects: 125 (11, 239), Statins: 48 (-105, 201), No Statins: 199 (47, 352); 3-day avg: All subjects: 161 (39, 283), Statins: 1 (-170, 171), No Statins: 306 (141, 472); 5-day avg: All subjects: 257 (100, 413), Statins: 15 (-210, 240), No Statins: 445 (240, 649); 7-day avg: All subjects: 176 (-68, 419), Statins: 43 (-297, 382), No Statins: 283 (-23, 589); 9-day avg: 265 (41, 489), Statins: 160 (-158, 478), No Statins: 355 (65, 646) sP-selectin (ng/mL): 1-day avg: All subjects: 1.84 (-0.62, 4.30), Clopidogrel: 0.00 (-2.80, 2.81), No Clopidogrel: 1.72 (-0.42, 3.86); 3-day avg: All subjects: 1.90 (-0.79, 4.60), Clopidogrel: -0.67 (-3.95, 2.60), No Clopidogrel: 1.60 (-0.76, 3.96); 5-day avg: All subjects: 2.97 (-0.47, 6.41), Clopidogrel: -0.18</p>

Study	Design	Concentrations	CO Effect Estimates (95% CI)
			(-4.38, 4.01); No Clopidogrel: 3.04 (0.06, 6.01); 7-day avg: All subjects: 6.74 (0.75, 12.73), Clopidogrel: 2.24 (-4.22, 8.71); No Clopidogrel: 6.78 (1.60, 3.96); 9-day avg: All subjects: 6.96 (1.20, 12.72); Clopidogrel: 2.0 (-4.40, 8.48); No Clopidogrel: 5.54 (0.46, 10.6)
Author: Liao et al. (2005, 088677)	Health Outcome: Various measures of hemostasis/ inflammation Study Design: Cohort Statistical Analyses: Linear regression Age Groups Analyzed: 45-64 yr Sample Description: 10,208 subjects from the Atherosclerosis Risk in Communities Study	Averaging Time: 24 h Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Increment: 0.6 ppm Regression coefficients [SE] Lags examined (days): 1 Lag 1: Fibrinogen (mg/dL): -0.16 (0.67) Factor VIII-C (%): 0.45 (0.42) vWF %: -0.29 (0.50) WBC (x 10 ³ /mm ³): 0.003 (0.017) Albumin (g/dL): -0.018 (0.003)** ** p < 0.01
Author: Ljungman et al. (2009, 191983)	Health Outcome: Plasma Interleukin-6 (IL-6), Fibrinogen Study Design: Panel/Field Statistical Analyses: Linear Mixed Effects Model Location: Athens, Greece; Augsberg, Germany; Barcelona, Spain; Helsinki, Finland; Rome, Italy; Stockholm, Sweden Age Groups Analyzed: 35-80 yr (mean = 62.2 yr) Sample Description: 955 subjects who had experienced MI between 4 mo and 6 yr before start of the study	Averaging Time: 24 h Mean (SD) unit: Individual cities: 0.29-1.48 mg/m ³ Mean for all cities: 0.78 mg/m ³ Range (percentiles): 25th = 0.56; 75th = 0.90 (for mean of all cities) Copollutant: (mean for all cities) NO ₂ : r = 0.69 PM ₁₀ : r = 0.47 PM _{2.5} : r = 0.55 PNC: r = 0.67	Increment: 0.34 mg/m ³ Change of IL-6 % of overall mean per IQ range increase Genotypes: 1 1, 1 2, 2 2 IL6 rs2069832 1 1: 2.0 (0.3, 3.6); 1 2: -0.2 (-1.7, 1.3); 2 2: -2.0 (-4.7, 0.8); p-value: 0.03 IL6 rs2069840 1 1: 2.0 (0.3, 3.8); 1 2: 0.4 (-0.9, 1.7); 2 2: -1.2 (-3.4, 1.1); p-value: 0.04 IL6 rs2069845 1 1: 1.9 (0.2, 3.5); 1 2: -0.1 (-1.5, 1.4); 2 2: -1.6 (-4.3, 1.2); p-value: 0.31 FGA rs2070011 1 1: 1.0 (-0.7, 2.7); 1 2: 0.7 (0.6, 2.0); 2 2: 0.4 (-1.9, 2.7); p-value: 0.64 FGB rs1800790 1 1: -0.2 (-1.8, 1.3); 1 2: 2.1 (0.4, 3.8); 2 2: 4.5 (1.1, 8.0); p-value: 0.02
Author: Pekkanen et al. (2000, 013250)	Health Outcome: Fibrinogen Study Design: Cohort Statistical Analyses: Logistic regression Location: London, England Age Groups Analyzed: 35-55 yr Sample Description: 7,205 office workers	Averaging Time: 8 h Mean (SD) unit: 1.4 mg/m ³ Range (Min, Max): Min = NR, Max = 9.9 Copollutant correlation: PM ₁₀ : r = 0.57 NO ₂ : r = 0.81 SO ₂ : r = 0.61 O ₃ : r = -0.45	Increment: 1.6 mg/m ³ % Change in fibrinogen concentration [p value]; Lags examined: 0, 1, 2, 3 Lag 0: 1.43 (<0.01); Lag 1: 1.49 (<0.01); Lag 2: 1.59 (<0.01); Lag 3: 1.26 (<0.01) OR for having Fibrinogen above 3.19 g/l [p value] Lags examined: 0, 1, 2, 3 Lag 0: 1.17 (0.05); Lag 1: 1.09 (0.31); Lag 2: 1.14 (0.11); Lag 3: 1.22 (<0.01)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Ruckerl et al. (2006, 088754)	Health Outcome: Blood markers of inflammation and coagulation Study Design: Panel	Averaging Time: 24 h Mean (SD) unit: 0.52 mg/m ³	Increment: 0.27 mg/m ³ OR Estimate for blood marker >90th percentile [Lower CI, Upper CI]
Period of Study: 2000-2001	Statistical Analyses: Linear and logistic regression (fixed effects)	Range (Min, Max): 0.11, 1.93	Lags examined (h): 0-23, 24-47, 48-71, 5-day avg CRP (C-reactive protein) 0-23: 0.9 (0.7-1.2); 24-47: 1.0 (0.7-1.5); 48-71: 1.5 (1.1-2.1); 5-day avg 1.1 (0.8-1.6)
Location: Erfert, Germany	Age Groups Analyzed: 51-76 yr (mean = 66 yr) Sample Description: 57 male patients with CHD	Copollutant correlation: NO ₂ : r = 0.82	ICAM-1 (Intercellular adhesion molecule 1) 0-23: 0.8 (0.6-1.0); 24-47: 1.5 (1.2-1.9); 48-71: 1.7 (1.3-2.3); 5-day avg 1.2 (1.0-1.6) % of change from the mean of blood marker vWF (von Willebrand factor antigen) 0-23: 4.4 (1.4- 7.5); 24-47: 2.7 (-0.8 to 6.1); 48-71: 2.0 (-1.7 to 5.8); 5-day avg: 4.9 (1.0-8.8)
Author: Ruckerl et al. (2007, 156931)	Health Outcome: Interleukin-6, C-reactive protein, Fibrinogen Study Design: Panel/Cohort	Averaging Time: 24 h Mean (SD) unit: Athens: 1.48 mg/m ³ Augsburg: 0.58 mg/m ³ Barcelona: 0.59 mg/m ³ Helsinki: 0.31 mg/m ³ Rome: 1.40 mg/m ³ Stockholm: 0.29 mg/m ³	Increment: 0.34 mg/m ³ % Change in mean [Lower CI, Upper CI] Lags examined: 0, 1, 2, 5-day avg
Period of Study: May 2003-July 2004	Statistical Analyses: Linear regression (mixed effects)	Range (Min, Max): NR	(Pooled estimates) Interleukin-6 Lag 0: 0.57 (-0.63 to 1.79) Lag 1: 0.44 (-0.79 to 1.68); Lag 2: -2.36 (-4.82 to 0.17) 5-day avg: -0.28 (-2.53 to 2.02)
Location: 6 cities across Europe: Athens, Greece; Augsburg, Germany; Barcelona, Spain; Helsinki, Finland; Rome, Italy; Stockholm, Sweden	Age Groups Analyzed: 37-81 yr Sample Description: 1,003 MI survivors who had at least 2 valid repeated blood samples	Copollutant: NR	C-reactive protein Lag 0: -0.01 (-1.72 to 1.73) Lag 1: -1.51 (-3.30 to 0.32) Lag 2: -2.35 (-6.84 to 2.36); 5-day avg: -0.85 (-5.37 to 3.90) Fibrinogen Lag 0: 0.24 (-0.54 to 0.92) Lag 1: 0.32 (-0.35 to 1.00); Lag 2: -0.44 (-1.11 to 0.23) 5-day avg: 0.12 (-0.81 to 1.05)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Rudez et al. (2009, 193783)	Health Outcome: Platelet aggregation, thrombin generation, Fibrinogen, C-reactive protein	Averaging Time: 24 h Median (SD) unit: 333 µg/m³	Increment: NR Estimated Changes [Lower CI, Upper CI]
Period of Study: January 2005-December 2006	Study Design: Panel Statistical Analyses: Linear regression	Range (percentiles): 25th = 276; 75th = 412	Platelet Aggregation Parameters Maximal Platelet Aggregation: D0-6: -3.6 (-9.3, 2.1); D0-12: -4.7 (-11.0, 1.5); D0-24: -2.6 (-7.9, 2.7); I24-48: -1.1 (-7.2, 4.9); I48-72: 8.4 (2.5, 14.3); I72-96: -0.1 (-5.1, 5.0); D+I0-96: 9.5 (1.6, 17.4)
Location: Rotterdam, the Netherlands	Age Groups Analyzed: Mean = 41 yr Sample Description: 40 healthy individuals	Copollutant: PM ₁₀ : r >0.6 NO: r >0.6 NO ₂ : r >0.6 O ₃ : -0.4 ≥ r ≥ -0.6	Late Aggregation: D0-6: 10.5 (0.8, 20.3); D0-12: 11.6 (1.2, 21.9); D0-24: 11.2 (1.4, 21.0); I24-48: 7.5 (-2.2, 17.1); I48-72: 18.1 (8.4, 27.8); I72-96: 4.2 (-5.5, 13.9); D+I0-96: 20.4 (8.4, 32.4)
			Thrombin Generation ETP D0-6: -1.51 (-3.7, 0.80); D0-12: -1.1 (-3.4, 1.1); D0-24: -1.5 (-3.9, 0.9); I24-48: -0.7 (-3.4, 2.0); I48-72: 0.8 (-1.9, 3.4); I72-96: 3.5 (0.8, 6.2); D+I0-96: 0.8 (-2.7, 4.3)
			Peak D0-6: -2.5 (-6.3, 1.3) D0-12: -1.9, (-5.7, 1.9); D0-24: -3.3 (-7.3, 0.7); I24-48: -1.3 (-6.1, 3.6); I48-72: -0.5 (-5.0, 4.0) I72-96: 3.8 (-0.8, 8.4) D+I0-96: -1.7 (-7.5, 4.2)
			Lag Time D0-6: 1.0 (-0.5, 2.5); D0-12: 1.0 (-0.5, 2.5); D0-24: 1.6 (0.1, 3.1); I24-48: 0.4 (-1.3, 2.2); I48-72: -1.0 (-2.7, 0.7); I72-96: -1.5 (-3.2, 0.2); D+I0-96: 0.1 (-2.1, 2.2)
			Inflammatory Markers Fibrinogen I24-48: 0.0 (-1.7, 1.8); I48-72: 0.0 (-1.8, 1.9) I72-96: -0.1 (-1.9, 1.7)
			CRP I24-48: 3.2 (-6.4, 12.8); I48-72: -1.9 (-12.5, 8.7); I72-96: -4.5 (-15.3, 6.3)
Author: Steinvil et al. (2008, 188893)	Health Outcome: Various measures of inflammation sensitive biomarkers	Averaging Time: 24 h Mean (SD) unit: 0.8 ppm	Increment: 0.3 ppm
Period of Study: 2003-2006	Study Design: Cohort Statistical Analyses: Linear regression	Range (percentiles): 25th = 0.7; 75th = 1.0	Regression co-efficient [Lower CI, Upper CI]
Location: Tel Aviv, Israel	Age Groups Analyzed: Mean = 46 yr Sample Description: 3,659 subjects living within 11 km of monitoring site	Copollutant: correlation PM ₁₀ : r = 0.75 NO ₂ : r = 0.857 SO ₂ : r = 0.671 O ₃ : r = -0.656	Lags examined (days): 0, 1, 2, 3, 4, 5, 6, 7, last wk avg Fibrinogen: Men Lag 0: -3.3 (-6.1 to -0.6); Lag 1: -2.6 (-5.5 to 0.4); Lag 2: -3.4 (-6.6 to -0.3); Lag 3: -3.4 (-6.5 to -0.2); Lag 4: -5.9 (-8.9 to -2.9); Lag 5: -4.7 (-7.8 to -1.6); Lag 6: -2.0 (-5.1 to 1.0); Lag 7: -2.7 (-5.7 to 0.2); Last wk avg: -7.7 (-12.1 to -3.3)
			Notes: No effect on fibrinogen among women. CO had no effect on CRP among men and no effect on CRP and WBC among women for all Lag times examined.

VARIOUS MEASURES OF CARDIOVASCULAR HEALTH

Author: Briet et al. (2007, 093049)	Health Outcome: Endothelial function, Reactive Hyperemia	Averaging Time: 24 h	Increment: NR
Period of Study: NR	Study Design: Case-crossover	Mean (SD) unit: NR	β-Coefficient [Lower CI, Upper CI]
Location: Paris, France	Statistical Analyses: Multiple regression models	Range (Min, Max): NR	Flow-mediated Brachial Artery Dilatation: -0.68 (-1.22, -0.15)
	Age Groups Analyzed: 18-35 yr	Copollutant: PM _{2.5} , PM ₁₀ , NO, NO ₂ , SO ₂	Small Artery Reactive Hyperemia: 10.46 (1.73, 19.31)
	Sample Description: 40 healthy white male nonsmokers		

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Nautiyal et al. (2007, 190301) Period of Study: August 1999-May 2000 Location: Mandi Gobindgarh, India Morinda, India	Health Outcome: Various measures of cardiovascular health via ECG (Minnesota Code) Study Design: Cross-sectional Statistical Analyses: NR Age Groups Analyzed: +15 yr Sample Description: 200 total survey participants (100/town)	Averaging Time: NR Mean (SD) unit: NR Range (Min, Max): Morinda Pure residential Site: 0-1 ppm GT Road Site: 2-3 ppm Copollutant: PM _{2.5} , PM ₁₀ , NO _x , SO _x	Increment: NR RR Estimate [Lower CI, Upper CI] Lags examined: NR No quantitative results presented
Author: Wellenius et al. (2007, 092830) Period of Study: February 2002-March 2003 Location: Boston, MA	Health Outcome: Congestive heart failure Study Design: Cohort (retrospective) Statistical Analyses: Linear mixed models Age Groups Analyzed: 33-88 yr. Sample Description: 28 patients with CHF and impaired systolic function	Averaging Time: 24 h Mean (SD) unit: 0.44 ppm Range (IQR): 0.20 ppm Copollutant: PM _{2.5} : r = 0.35 NO ₂ , SO ₂ , O ₃ , BC	Increment: NR RR Estimate [Lower CI, Upper CI] Lags examined: 0, 1, 2, 3 Results presented graphically

Table C-2. Studies of CO exposure and cardiovascular hospital admissions and ED visits.

Study	Design	Concentrations	CO Effect Estimates (95% CI)
STROKE			
Author: Chan et al. (2006, 090193) Period of Study: 1997-2002 Location: Taipei, Taiwan	ED Visits Health Outcome (ICD9): Cerebrovascular disease (430-437); Strokes (430-434); Hemorrhagic stroke (430-432); Ischemic stroke (433-434) Study Design: Time-series Statistical Analyses: GAM Age Groups Analyzed: All Sample Description: NR	Averaging Time: 8 h Mean (SD) unit: 1.7 ppm Range (Min, Max): 0.6, 4.4 Copollutant: correlation O ₃ : r = 0.30 SO ₂ : r = 0.63 NO ₂ : r = 0.77 PM _{2.5} : r = 0.44 PM ₁₀ : r = 0.47	Increment: 0.8 ppm OR Estimate [Lower CI, Upper CI] Lags (days) examined 0, 1, 2, 3 Cerebrovascular disease: Lag 2, 1.03 (1.01, 1.06) Stroke: Lag 2, 1.03 (1.01, 1.05) Ischemic and Hemorrhagic stroke: not significant. Cerebrovascular 2 pollutant model: CO + O ₃ : Lag 2, 1.03 (1.01-1.05) CO + PM _{2.5} : Lag 2, 1.02 (1.00-1.04) CO + PM ₁₀ : Lag 2, 1.03 (1.01-1.05)
Author: Henrotin et al. (2007, 093270) Period of Study: 1994-2004 Location: Dijon, France	Health Outcome (ICD9 or ICD10): Stroke (Ischemic & Hemorrhagic) Study Design: Bidirectional case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: ≥ 40 yr Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: 683 µg/m ³ Range (Min, Max): 0, 4014 Copollutant: NR	Increment: 10 µg/m ³ OR Estimate [Lower CI, Upper CI] Lags (days) examined: 0, 1, 2, 3. Ischemic: Lag 0: 0.999 (0.997-1.001) Lag 1: 0.998 (0.997-1.001) Lag 2: 0.999 (0.998-1.001) Lag 3: 1.000 (0.998-1.001) Hemorrhagic: Lag 0: 1.000 (0.996-1.004) Lag 1: 1.001 (0.997-1.005) Lag 2: 0.999 (0.995-1.004) Lag 3: 0.998 (0.994-1.002) Also not significant when stratified by sex.

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Maheswaran et al. (2005, 090769) Period of Study: 1994-1998 Location: Sheffield, UK	Health Outcome (ICD9 or ICD10): Stroke deaths (ICD9: 430-438); Stroke Hospital admissions (ICD10: I60-I69) Study Design: Ecological Statistical Analyses: Poisson regression Age Groups Analyzed: ≥ 45 yr Sample Description: 1,030 census districts	Averaging Time: NR Mean (SD) unit: Quintiles Range (Min, Max): NR Copollutant: NR	Increment: NR – Quintiles of exposure RR Estimate [Lower CI, Upper CI] Adjusted for sex, age, deprivation, smoking. Quintiles: 2nd: 1.04 (0.94-1.16) 3rd: 1.01 (0.91-1.13) 4th: 1.10 (0.99-1.23) 5th: 1.11 (0.99-1.25) Adjusted for sex, age: 2nd: 1.11 (1.01-1.22) 3rd: 1.15 (1.04-1.27) 4th: 1.29 (1.17-1.42) 5th: 1.37 (1.24-1.52)
Author: Tsai et al. (2003, 080133) Period of Study: 1997-2000 Location: Kaohsiung, Taiwan	Study Design: Case-crossover Health Outcome (ICD9 or ICD10): Cerebrovascular diseases: ICD9: 430 to 438 (Subarachnoid hemorrhagic stroke 430, Primary intracerebral hemorrhage (PIH): 431-432, Ischemic stroke (IS): 433-435). Statistical Analyses: NR Age Groups Analyzed: All Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: 0.79 ppm Range (Min, Max): 0.24, 1.72 Copollutant: NR	Increment: 0.8 ppm (IQR) RR Estimate [Lower CI, Upper CI] Lag (days): 0-2 >20°C PIH: OR 1.21 (1.09-1.34) IS: OR 1.21 (1.14-1.28) <20°C PIH: OR 1.18 (0.80-0.72) IS: OR 1.77 (1.31-2.39) Notes: 2-pollutant models: PIH results persisted when adjusting for SO ₂ and O ₃ IS results persisted when controlling for PM ₁₀ , SO ₂ and O ₃
Author: Villeneuve et al. (2006, 090191) Period of Study: 1992-2002 Location: Edmonton, Canada	ED Visits (within 5 hospitals) Health Outcome (ICD9): Stroke (430-438); Ischemic (434-436) Hemorrhagic (430-432); Transient Ischemic Attack (435) Study Design: Case-crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: 65+ yr Sample Description: 12,422 visits	Averaging Time: 24 h Mean (SD) unit: 0.8 ppm Range (percentiles): 25th = 0.5; 75th = 1.0 Copollutant correlation: O ₃ : r = -0.54 PM _{2.5} : r = 0.43 PM ₁₀ : r = 0.30	Increment: 0.5 ppm OR Estimate [Lower CI, Upper CI] Lags (days) examined: 0, 1 & 0-2 Ischemic (April-Sept) Lag 0: 1.16 (1.00, 1.33) Lag 1: 1.17 (1.01, 1.36) Lag 0-2: 1.32 (1.09, 1.60) Notes: - Not significant for all seasons or Oct-Mar. - Hemorrhagic: Not significant for all seasons or Oct-Mar, Apr-Sept. - Transient Ischemic Attack: Not significant for all seasons or Oct-Mar, Apr-Sept.
Author: Wellenius et al. (2005, 088685) Period of Study: NR Location: 9 U.S. cities: Chicago, Detroit, Pittsburgh, Cleveland, Birmingham, New Haven, Seattle, Minneapolis, Salt Lake City	ED Visits Health Outcome: Stroke among Medicare beneficiaries: (Ischemic, hemorrhagic) Study Design: Time-series Statistical Analyses: Logistic regression Age Groups Analyzed: ≥ 65 yr Sample Description: 155,503 visits	Averaging Time: NR Mean (SD) unit: NR Range (percentiles): 25th = 0.73; 50th = 1.02; 75th = 1.44 (ppm) Copollutant: correlation PM ₁₀ : r = 0.43	Increment: 0.71 ppm % Change [Lower CI, Upper CI] Lag: 0 Ischemic: 2.83 (1.23-4.46) Hemorrhagic: -1.61 (-4.79 to 1.68)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
ISCHEMIC HEART DISEASE			
Author: D'Ippoliti et al. (2003, 074311)	Hospital Admissions	Averaging Time: 24 h Mean (SD) unit: 4.4 mg/m ³	Increment: 1 mg/m ³ OR Estimate [Lower CI, Upper CI] ; lag:
Period of Study: 1995-1997	Health Outcome (ICD9): MI (410)	Range (percentiles): 25th = 2.8; 75th = 4.3	Lags examined (days): 0, 1, 2, 3, 4, 0-2 Acute MI Lag 0: 1.021 (0.988-1.054) Lag 1: 1.020 (0.988-1.054) Lag 2: 1.033 (1.001-1.066) Lag 3: 1.010 (0.982-1.040) Lag 4: 1.025 (0.996-1.055) Lag 0-2: 1.044 (1.000-0.89)
Location: Rome, Italy	Study Design: Case-crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: 18+ yr Sample Description: 6,531 patients.	Copollutant: correlation TSP: r = 0.35 SO ₂ : r = 0.56 NO ₂ : r = 0.31	
Author: Hosseinpoor et al. (2005, 087413)	Health Outcome: Angina Pectoris (ICD9: 413; ICD10: I20)	Averaging Time: 24 h Mean (SD) unit: 10.8 mg/m ³	Increment: 1 mg/m ³ RR Estimate [Lower CI, Upper CI]
Period of Study: 1996-2001	Study Design: Time series Statistical Analyses: Poisson regression Age Groups Analyzed: All Sample Description: NR	Range (Min, Max): 1.6, 57.8 Copollutant: NR	Lags examined (days): 0, 1, 2, 3 Lag 1: 1.00957 (1.00600-1.01315)
Author: Lanki et al. (2006, 089788)	Health Outcome: First AMI (ICD9: 410; ICD10: I21, I22)	Averaging Time: 24 h Mean (SD) unit: NR Unit: mg/m ³	Increment: 0.2 mg/m ³ RR Estimate [Lower CI, Upper CI] ; lag:
Period of Study: 1994-2000	Study Design: Time series Statistical Analyses: Poisson regression (GAM) Age Groups Analyzed: 35+ yr Sample Description: 26,854 Hospital Admissions	Range (percentiles): Augsburg, Germany 25th = 0.7; 75th = 1.1 Barcelona, Spain 25th = 0.6; 75th = 1.4 Helsinki, Finland 25th = 0.3; 75th = 0.5 Rome, Italy 25th = 1.7; 75th = 2.9 Stockholm, Sweden 25th = 0.3; 75th = 0.5 Copollutant: correlation PM ₁₀ : r = 0.21 – 0.56 NO ₂ : r = 0.43 – 0.75 O ₃ : r = -.023 – .020	Lags examined: 0, 1, 2, 3 All 5 cities: Lag 0: 1.005 (1.000-1.010) Lag 1: 1.002 (0.996-1.007) Lag 2: 1.002 (0.997-1.007) Lag 3: 0.998 (0.992-1.003) 3 cities with Hospital Discharge Register(HDR): Lag 0: 1.007 (1.001-1.012) Lag 1: 1.002 (0.996-1.008) Lag 2: 1.003 (0.998-1.009) Lag 3: 1.004 (0.988-1.020) 3 cities with HDR – ≤ 7years Fatal: Lag 0: 1.027 (1.006-1.048) Lag 1: 1.021 (1.000-1.042) Lag 2: 1.018 (0.997-1.039) Lag 3: 1.015 (0.994-1.037) Non-Fatal: Lag 0: 1.001 (0.995-1.008) Lag 1: 1.000 (0.994-1.007) Lag 2: 1.004 (0.998-1.011) Lag 3: 0.999 (0.992-1.006) 3 cities with HDR – ≥ 7years Fatal: Lag 0: 1.009 (0.992-1.006) Lag 1: 1.001 (0.985-1.018) Lag 2: 1.006 (0.990-1.023) Lag 3: 1.000 (0.983-1.017) Non-Fatal: Lag 0: 1.015 (1.004-1.086) Lag 1: 1.006 (0.995-1.017) Lag 2: 0.995 (0.983-1.006) Lag 3: 0.998 (0.987-1.009)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Lee et al. (2003, 095552) Period of Study: 1997-1999 Location: Seoul, Korea	Study Design: Time-series Health Outcome (ICD9 or ICD10): Angina: ICD10: I20 AMI: ICD10: I21-I23 Other Acute IHDs: ICD10: I24 Statistical Analyses: Poisson regression, GAM Age Groups Analyzed: 64+ yr Sample Description: 822 days	Averaging Time: Daily max Mean (SD) unit: 1.8 ppm Range (percentiles): 25th = 1.2 75th = 2.2 Copollutant: correlation $PM_{2.5}$: 0.60 SO_2 : 0.81 NO_2 : 0.79 O_3 : -0.39	Increment: 1 ppm (IQR) RR Estimate [Lower CI, Upper CI] Lags examined (days): 0, 1, 2, 3, 4, 5, 6 All yr: Lag 5: All ages: 0.94 (0.91-0.98) Lag 5: 64+ age: 1.07 (1.01-1.13) Summer: Lag 5: All ages: 1.19 (1.02-1.38) Lag 5: 64+ age: 1.60 (1.27-2.03) 2-pollutant model: Lag 5: 64+ age: $CO + PM_{10}$: 1.04 (0.98-1.11)
Author: Maheswaran et al. (2005, 090769) Period of Study: 1994-1998 Location: Sheffield, UK	Emergency Hospital Admission Health Outcome (ICD9): CHD (410-414) Study Design: Ecological Statistical Analyses: Poisson regression Age Groups Analyzed: 45+ yr Sample Description: 11,407 Emergency Hospital Admissions for CHD in patients 45+ yr (within 1,030 census districts)	Averaging Time: NR Mean (SD) unit: Quintiles Range (Min, Max): NR Copollutant: NR	Increment: NA RR Estimate [Lower CI, Upper CI] Lowest quintile reference category Adjusted for sex, age, deprivation, smoking: 2nd: 0.97 (0.89-1.07) 3rd: 0.94 (0.86-1.04) 4th: 0.96 (0.97-1.06) 5th: 0.88 (0.79-0.98) Adjusted for sex, age: 2nd: 1.09 (1.00-1.19) 3rd: 1.15 (1.05-1.26) 4th: 1.19 (1.09-1.30) 5th: 1.20 (1.09-1.32)
Author: Mann et al. (2002, 036723) Period of Study: 1988-1995 Location: Southern California	Health Outcome (ICD9): IHD (IHD) (410-414); MI (410) Study Design: Time series Statistical Analyses: Poisson regression, GAM Age Groups Analyzed: All Sample Description: 54,863 IHD admissions among Southern California Kaiser-Permanente members (within 20km of monitor)	Averaging Time: 8 h Mean (SD) unit: 2.07 ppm Range (Min, Max): 0.30, 11.8 Copollutant: correlation Ranging across 7 regions: NO_2 : r = 0.64, 0.86 O_3 : r = -0.37, 0.28 PM_{10} : r = 0.15, 0.40	Increment: 1 ppm % Change [Lower CI, Upper CI] Lags examined (days): 0, 1, 2, 2 ma, 3 ma, 4 ma With arrhythmia: Lag 0: 2.99 (1.80-4.99) Lag 1: 1.51 (0.37-2.66) Lag 2: 1.26 (0.15-2.38) 2 ma: 2.66 (1.40-3.94) 3 ma: 2.59 (1.27-3.92) 4 ma: 2.25 (0.90-3.63) With CHF: Lag 0: 3.60 (1.620-5.63) Lag 1: 3.34 (1.48-5.22) Lag 2: 1.90 (0.11-3.72) 2 ma: 4.23 (2.13-6.37) 3 ma: 4.14 (1.96-6.37) 4 ma: 4.07 (1.81-6.38) Without secondary diagnosis: Lag 0: 1.62 (0.65-2.59) Lag 1: 1.45 (0.54-2.37) Lag 2: 0.92 (0.04-1.82) 2 ma: 1.83 (0.80-2.86) 3 ma: 1.79 (0.72-2.87) 4 ma: 1.82 (0.71-2.94)
Author: Szyszkowicz (2007, 193793) Period of Study: 1997-2003 Location: Montreal, Canada	Study Design: Time-series Health Outcome (ICD9 or ICD10): ED Visits. IHD: ICD9: 410-414 Statistical Analyses: Poisson regression (GLMM) Age Groups Analyzed: All Sample Description: 4,979 ED Visits	Averaging Time: 24 h Mean (SD) unit: 0.5 ppm Range (Min, Max): 0.1, 3.1 Copollutant: NR	Increment: 0.2 ppm % Change [Lower CI, Upper CI] ; lag: Lags examined (days): 0, 1 All Patients: Lag 0: 5.4 (2.3-8.5) Males: Lag 0: 7.5 (3.6-11.6) Females: Lag 0: 2.7 (-2.0 to 7.6) Ages \geq 64 All Patients: Lag 0: 4.9 (1.3-8.7) Males: Lag 0: 7.5 (2.6-12.6) Females: Lag 0: 2.4 (-3.0 to 0) Lag 1 not significant for all results

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: von Klot et al. (2005, 088070) Period of Study: 1992-2001 Location: 5 European cities: Augsburg, Germany Barcelona, Spain Helsinki, Finland Rome, Italy Stockholm, Sweden	Health Outcome: Hospital cardiac (mi), angina, dysrhythmia, heart failure) re-admissions Study Design: Prospective Cohort Statistical Analyses: Poisson regression Age Groups Analyzed: All Sample Description: 22,006 survivors of first MI	Averaging Time: 24 h Unit: mg/m ³ Mean (SD) unit: Augsburg, Germany: 0.93 Barcelona, Spain: 1.00 Helsinki, Finland: 0.42 Rome, Italy: 2.21 Stockholm, Sweden: 0.43 Range (Min, Max): NR Copollutant: correlation PM_{10} : r = 0.21 – 0.57 NO_2 : r = 0.44 – 0.75 O_3 : r = -.027 – 0.47	Increment: 0.2 mg/m ³ (0.172 ppm) RR Estimate [Lower CI, Upper CI] Lags examined (days): 0, 1, 2, 3 Lag 0: Mi: 1.022 (0.998-.047) Angina: 1.009 (0.992-.02) Cardiac: 1.014 (1.001-.026)
HEART FAILURE			
Author: Lee et al. (2007, 090707) Period of Study: 1996-2004 Location: Kaohsiung City, Taiwan	Hospital Admissions Health Outcome (ICD9): CHF (428) Study Design: Case-crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All Sample Description: 13,475 Hospital Admissions (63 Hospitals)	Averaging Time: 24 h Mean (SD) unit: 0.76 ppm Range (Min, Max): 0.14, 1.72 Copollutant: NR	Increment: 0.31 ppm OR Estimate [Lower CI, Upper CI] Lag examined (days): 0-2 $\geq 25^\circ C$: 1.19 (1.09-1.31) $<25^\circ C$: 1.39 (1.24-1.54) Adjusted for PM_{10} : $\geq 25^\circ C$: 1.15 (1.04-1.27) $<25^\circ C$: 1.21 (1.206-1.38) Adjusted for SO_2 : $\geq 25^\circ C$: 1.23 (1.11-1.36) $<25^\circ C$: 1.39 (1.24-1.55) Adjusted for NO_2 : $\geq 25^\circ C$: 1.22 (1.08-1.39) $<25^\circ C$: 0.94 (0.81-1.10) Adjusted for O_3 : $\geq 25^\circ C$: 1.17 (1.07-1.28) $<25^\circ C$: 1.36 (1.22-1.51)
Author: Symons et al. (2006, 091258) Period of Study: 2002 (April-November) Location: Johns Hopkins Bayview Medical Center, Baltimore, MD	Hospital Admissions Health Outcome: NR Study Design: Case-crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All Sample Description: 398 Hospital Admissions for CHF	Averaging Time: 24 h Mean (SD) unit: 0.4 ppm Range (Min, Max): 0.1, 1.0 Copollutant: NR	Increment: 0.2 ppm OR Estimate [Lower CI, Upper CI] Lags examined (days): 0, 1, 2, 3, cum 1, cum 2, cum 3 Lag 0: 0.86 (0.67-1.11) Lag 1: 0.90 (0.70-1.17) Lag 2: 0.96 (0.73-1.26) Lag 3: 0.88 (0.67-1.16) Cum. Lag1: 0.82 (0.60-1.13) Cum. Lag2: 0.80 (0.54-1.17) Cum. Lag3: 0.27 (0.46-1.14)
Author: Wellenius et al. (2005, 087483) Period of Study: 1987-1999 Location: Pittsburgh, PA	Hospital Admissions Health Outcome (ICD9): CHF (428, 428.1) Study Design: Case-crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: 65+ yr Sample Description: 54,019 Hospital Admissions among Medicare beneficiaries	Averaging Time: 24 h Mean (SD) unit: 1.03 ppm Range (percentiles): 25th = 0.68; 75th = 1.23 Copollutant: correlation PM_{10} : r = 0.57 NO_2 : r = 0.70 O_3 : r = -0.25 SO_2 : r = 0.54	Increment: 0.55 ppm % Change [Lower CI, Upper CI] Lags examined (days): 0, 1, 2, 3 Lag 0: Single pollutant model: 4.55 (3.33-5.79) Adjusted for PM_{10} : 5.18 (3.49-6.89) Adjusted for NO_2 : 4.84 (3.06-6.66) Adjusted for O_3 : 4.35 (3.08-5.64) Adjusted for SO_2 : 4.51 (3.15-5.90)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Yang (2008, 157160)	Hospital Admissions	Averaging Time: 24 h	Increment: NR
Period of Study: 1996-2004	Health Outcome: CHF	Mean (SD) unit: 1.26 ppm	OR Estimate [Lower CI, Upper CI]
Location: Taipei, Taiwan	Study Design: Case-crossover	Range (Min, Max): 0.12, 3.66	Lags examined (days): 0, 1, 2
	Statistical Analyses: NR	Copollutant: PM ₁₀ , NO ₂ , O ₃ , SO ₂	Single Pollutant Model
	Age Groups Analyzed: NR		Warm days (>20°C): 1.24 (1.16, 1.33)
	Sample Description: 24,240 CHF HA from 47 hospitals		Cool days (<20°C): 1.05 (0.96, 1.15)
			Two Pollutant Models
			Warm days ($\geq 20^{\circ}\text{C}$)
			Adjusted for PM ₁₀ : 1.16 (1.08, 1.26)
			Adjusted for NO ₂ : 1.02 (0.92, 1.13)
			Adjusted for O ₃ : 1.25 (1.17, 1.34)
			Adjusted for SO ₂ : 1.32 (1.22, 1.42)
			Cool days ($< 20^{\circ}\text{C}$)
			Adjusted for PM ₁₀ : 1.09 (0.97, 1.21)
			Adjusted for NO ₂ : 1.07 (0.92, 1.25)
			Adjusted for O ₃ : 0.89 (0.80, 0.99)
			Adjusted for SO ₂ : 1.03 (0.92, 1.16)
CARDIOVASCULAR DISEASES – NON-SPECIFIC			
Author: Ballester et al. (2001, 013257)	ED Visits	Averaging Time: 24 h	Increment: 1 mg/m ³
Period of Study: 1994-1996	Health Outcome (ICD9: CVD (390-459); Heart diseases (410-414, 427, 428); cerebrovascular disease (430-438))	Mean (SD) unit: 6.2 mg/m ³	RR Estimate [Lower CI, Upper CI] ; lag:
Location: Valencia, Spain	Study Design: Time series	Range (Min, Max): 0.6, 17.8	Lags examined (days): 0, 1, 2, 3, 4, 5
	Statistical Analyses: Poisson regression	Copollutant: correlation BS: r = 0.64 NO ₂ : r = 0.03 SO ₂ : r = 0.74 O ₃ : r = -0.26	All cardiovascular: Lag 2: 1.0077 (0.9912-1.0138)
	Age Groups Analyzed: All		Heart Disease: Lag 1: 1.0092 (0.9945-1.0242)
	Sample Description: NR		Cerebrovascular Disease: Lag 1: 0.9874 (0.9646-1.0107)
Author: Ballester et al. (2006, 088746)	Health Outcome (ICD9: All CVD (390-459); Heart diseases (410-414, 427, 428))	Averaging Time: 8 h	Increment: 1 mg/m ³
Period of Study: 1995-1999	Study Design: Time series	Mean (SD) unit: Range across 14 cities, 1.4-2.8 mg/m ³	% Change [Lower CI, Upper CI]
Location: 14 Cities in Spain	Statistical Analyses: GAM	Range (percentiles): 10th = 0.4-1.7; 90th = 2.0-3.9	Lags examined (days): 0-1
	Age Groups Analyzed: All	Copollutant: NR	All CVD: Lag 0-1: 2.06 (0.65-3.48) Heart Disease: Lag 0-1: 4.15 (1.31-7.08)
Author: Barnett et al. (2006, 089770)	Hospital Admissions with CVDs	Averaging Time: 8 h	Increment: 0.9 ppm
Period of Study: 1998-2001	Health Outcome (ICD9: Arrhythmia (247); Cardiac Disease (390-429); Cardiac Failure (428); IHD (410-413); MI (410); Total CVD (390-459))	Mean (SD) unit: ppm Brisbane: 1.7 Canberra: 0.9 Melbourne: 1.0 Perth: 1.0 Sydney: 0.8 Auckland: 2.1 Christchurch: 0.5	% Change [Lower CI, Upper CI]
Location: Brisbane, Canberra, Melbourne, Perth, Sydney Australia	Study Design: Case-crossover	Range (Min, Max): ppm Brisbane: 0.0, 7.0 Canberra: 0.0, 5.8 Melbourne: 0.1, 8.0 Perth: 0.1, 4.0 Sydney: 0.0, 4.5 Auckland: 0.2, 7.9 Christchurch: 0.0, 5.4	Lags examined (days): 0-1 15-64 yr Arrhythmia: 2.5 (0.1-4.9) Cardiac: 1.7 (0.5-2.9) Cardiac Failure: 4.2 (0.6-7.8) IHD: 1.6 (-0.6 to 3.9) MI: 1.8 (-0.7 to 4.3) Total CVD: 1.2 (0.3-2.1) ≥ 65 yr Arrhythmia: 0.1 (-1.8 to 2.1) Cardiac: 2.8 (1.3-4.4) Cardiac Failure: 6.0 (3.5-8.5) IHD: 2.3 (0.9-3.8) MI: 2.9 (0.8-4.9) Total CVD: 2.2 (0.9-3.4)
Auckland & Christchurch, New Zealand	Statistical Analyses: Conditional logistic regression		
	Age Groups Analyzed: 15-64 yr & ≥ 65 yr		
	Sample Description: NR		
		Copollutant NR	

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Bell et al. (2009, 193780) Period of Study: 1999-2005 Location: 126 U.S. urban counties	Hospital Admissions with CVDs Health Outcome (ICD9): Cardiac failure (428); cerebrovascular events (430-438); heart rhythm disturbances (426-427); ihd (410-414,429); peripheral vascular disease (440-448) Study Design: Time series Statistical Analyses: Log-linear over-dispersed Poisson regression Age Groups Analyzed: ≥ 65 yr Sample Description: 9.3 million Medicare subjects	Averaging Time: 1 h Mean (SD) unit: 1.6 ppm Median (SD) unit: 1.3 ppm Median Range (Min, Max): 0.2, 9.7 Copollutant: PM _{2.5} : r = 0.26 NO ₂ : r = 0.56 EC: r = 0.48	Increment: 1 ppm % Change [Lower CI, Upper CI] Lags examined (days): 0-2 Lag 0: Single pollutant model: 0.96 (0.79-1.12) Adjusted for PM _{2.5} : 0.76 (0.57-0.96) Adjusted for NO ₂ : 0.55 (0.36-0.74) Adjusted for EC: 0.97 (0.38-1.57)
Author: Chang et al. (2005, 080086) Period of Study: 1997-2001 Location: Taipei, Taiwan	Health Outcome (ICD9): CVD Hospital Admissions (410-429) Study Design: Case-crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All Sample Description: 74,509 CVD hospital admissions (47 Hospitals)	Averaging Time: 24 h Mean (SD) unit: 1.37 ppm Range (Min, Max): 0.37, 3.66 Copollutant: NR	Increment: 0.49 ppm OR Estimate [Lower CI, Upper CI] Lag examined (days): 0-2 ≥ 20°C: 1.090 (1.064-1.118) <20°C: 0.984 (0.927-1.044) Adjusted for PM ₁₀ : ≥ 20°C: 1.171 (1.132-1.211) <20°C: 0.946 (0.892-1.003) Adjusted for SO ₂ : ≥ 20°C: 1.232 (1.194-1.272) <20°C: 1.098 (1.034-1.165) Adjusted for NO ₂ : ≥ 20°C: 1.048 (1.003-1.095) <20°C: 0.983 (0.914-1.058) Adjusted for O ₃ : ≥ 20°C: 1.196 (1.161-1.232) <20°C: 1.092 (1.031-1.157)
Author: Filhol. (2008, 190260) Period of Study: January 2001-July 2003 Location: Sao Paulo, Brazil	ED Visits Health Outcome (ICD10): Hypertension and Cardiac Ischemic Disease (I10-I25) Study Design: Time series Statistical Analyses: Linear Poisson regression models Age Groups Analyzed: >18 yr Sample Description: 45,000 Cardiovascular emergency room visits from diabetic and non-diabetic patients (tertiary referral teaching hospital)	Averaging Time: 8 h Mean (SD) unit: 2.7 ppm Range (Min, Max): 0.7, 12.1 Copollutant: correlation PM ₁₀ : r = 0.69 NO ₂ : r = 0.58 SO ₂ : r = 0.52 O ₃ : r = 0.07	Increment: 1.2 ppm Regression Coefficients [SEM] Lags examined (days): 0, 1, 2 CVD Visits/Diabetes: Lag 0: 0.0575 (0.0410) Lag 1: -0.0056 (0.0418) Lag 2: -0.0324 (0.0426) 2-day moving avg: 0.0324 (0.0470) 3-day moving avg: 0.0074 (0.0528) 4-day moving avg: -0.0025 (0.0582) CVD Visits/Non-Diabetes: Lag 0: 0.0286 (0.0095) Lag 1: 0.0098 (0.0091) Lag 2: 0.0102 (0.0089) 2-day moving avg: 0.0271 (0.0108) 3-day moving avg: 0.0281 (0.0120) 4-day moving avg: 0.0306 (0.0131)
Author: Fung et al. (2005, 074322) Period of Study: 1995-2000 Location: Windsor, Ontario, Canada	Hospital Admissions of CVDs Health Outcome (ICD9): CHF (428); IHD (410-414); dysrhythmias (427) Study Design: Time series Statistical Analyses: GLM Age Groups Analyzed: All Sample Description: 11,632 Cardiac hospital admissions	Averaging Time: 24 h Mean (SD) unit: 1.3 ppm Range (Min, Max): 0.0, 11.8 Copollutant: correlation PM ₁₀ : r = 0.21 NO ₂ : r = 0.38 SO ₂ : r = 0.16 O ₃ : r = 0.10	Increment: 1.2 ppm % Change [Lower CI, Upper CI] Lags examined (days): 0, 0-1, 0-2 <65 yr Lag 0: -3.1 (-7.4 to 1.4) Lag 0-1: -2.7 (-8.1 to 3.0) Lag 0-2: -0.5 (-6.7 to 6.0) ≥ 65 yr Lag 0: 0.5 (-2.2 to 3.3) Lag 0-1: 2.3 (-1.1 to 5.9) Lag 0-2: 2.8 (-1.1 to 7.0)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Jalaludin et al. (2006, 189416) Period of Study: 1997-2001 Location: Sydney, Australia	ED Visits Health Outcome (ICD9): All cardiovascular (390-459); cardiac disease (390-429); IHD (410-413); cerebrovascular or stroke (430-438) Study Design: Time series Statistical Analyses: GLM & GAM Age Groups Analyzed: 65+ yr Sample Description: NR	Averaging Time: 8 h Mean (SD) unit: 0.82 ppm Range (Min, Max): 0.02, 4.63 Copollutant: correlation PM ₁₀ : r = 0.31 NO ₂ : r = 0.71 SO ₂ : r = 0.51 O ₃ : r = 0.19	Increment: 0.69 ppm % Change [Lower CI, Upper CI] Lags examined (days): 0, 1, 2, 3, 0-1 All Cardiovascular: Lag 0: 2.32 (1.45-3.19) Lag 1: 1.33 (0.47-2.20) Lag 0-1: 2.35 (1.39-3.32) Cardiac Disease: Lag 0: 2.52 (1.50-3.54) Lag 1: 1.85 (0.83-2.88) Lag 2: 1.11 (0.0-2.15) Lag 0-1: 2.85 (1.71-4.01) IHD: Lag 0: 2.83 (1.22-4.48) Lag 1: 1.58 (0.01-3.19) Lag 0-1: 2.86 (1.07-4.68) Stroke: No results were significant for Stroke. All CVD: Cool period: Lag 0: 3.26 (2.00-4.53) Cardiac Disease: Cool period: Lag 0: 3.43 (1.95-4.93) IHD: Cool period: Lag 0: 3.64 (1.28-6.06) Warm period: Lag 0: 2.29 (0.01-4.62) Stroke: Cool period: Lag 0: 3.54 (0.78-6.37)
			Notes: Cool: May to October Warm: November to April
Author: Koken et al. (2003, 049466) Period of Study: 1993-1997 Location: Denver, CO	Hospital Admissions for CVD Health Outcome (ICD9): MI (410-410.92); coronary atherosclerosis (414-414.05); pulmonary heart disease (416-416.9); cardiac dysrhythmia (427-427.9); CHF (428) Study Design: Time series Statistical Analyses: GLM Age Groups Analyzed: >65 yr Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: 0.9 ppm Range (Min, Max): 0.3, 1.6 Copollutant: correlation PM ₁₀ : r = 0.25 NO ₂ : r = 0.73 SO ₂ : r = 0.21 O ₃ : r = -0.40	Increment: 0.3 ppm % Change [Lower CI, Upper CI] Lags examined (days): 1, 2, 3, 4 CHF: Lag 3: 10.5 (0.1-22.0) CO not significantly associated with other Lag periods.
Author: Linn et al. (2000, 002839) Period of Study: 1992-1995 Location: Los Angeles, CA	Health Outcome: Hospital Admissions for Cardiovascular, Cerebrovascular, Pulmonary. Study Design: Time series Statistical Analyses: Ordinary least squares regression; Poisson regression Age Groups Analyzed: >30 yr Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: Winter: 1.7; Spring: 1.0; Summer: 1.2; Fall: 2.1 Range (Min, Max): Winter: 0.5, 5.3; Spring: 0.4, 2.2; Summer: 0.3, 2.7; Fall: 0.2, 4.3 Copollutant: correlation Winter: PM ₁₀ : r = 0.78; NO ₂ : r = 0.89; O ₃ : r = -0.43; Spring: PM ₁₀ : r = 0.54; NO ₂ : r = 0.92; O ₃ : 0.29 Summer: PM ₁₀ : r = 0.72; NO ₂ : r = 0.94; O ₃ : 0.03 Fall: PM ₁₀ : r = 0.58; NO ₂ : r = 0.84; O ₃ : r = -0.36	Increment: 1 ppm Co-efficient [SE] Lags examined (lags): 0, 1 Lag 0: Cardiovascular All: 0.032 (0.003)* (e.g. 3.2% increase) Winter: 0.038 (0.006)* Spring: 0.010 (0.015) Summer: 0.035 (0.014)* Fall: 0.027 (0.006)* Cerebrovascular All: 0.009 (0.007) Winter: -0.008 (0.014) Spring: 0.107 (0.033)* Summer: 0.030 (0.033) Fall: 0.008 (0.012) MI All: 0.040 (0.009) * CHF All: 0.025 (0.009)* Cardiac Arrhythmia All: 0.023 (0.009)* Stroke All: 0.044 (0.009)* Notes: * p < 0.05

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Metzger et al. (2004, 044222) Period of Study: 1993-2000 Location: Atlanta, GA	ED Visits (from 31 hospitals) Health Outcome (ICD9): Cardiovascular: IHD (410-414); Acute MI (410); Dysrhythmia (427); Cardiac Arrest (427.5); CHF (428); Peripheral Vascular & Cerebrovascular Disease (PVCD) (433-437, 440, 443, 444, 451-453); Atherosclerosis (440); Stroke (436) Study Design: Case-crossover Statistical Analyses: Poisson regression (GLM) Age Groups Analyzed: All Sample Description: 4,407,535 visits	Averaging Time: 1 h Median (SD) unit: 1.5 ppm Range (percentiles): 10th = 0.5; 90th = 3.4 Copollutant: correlation PM_{10} : r = 0.47 NO_2 : r = 0.68 SO_2 : r = 0.26 O_3 : r = 0.20	Increment: 1 ppm RR Estimate [Lower CI, Upper CI] Lags examined (days): 0-2ma All CVD: 1.017 (1.008-1.027) Dysrhythmia: 1.012 (0.993-1.031) CHF: 1.010 (0.988-1.032) IHD: 1.016 (0.999-1.034) PVCD: 1.031 (1.010-1.052)
Author: Peel et al. (2007, 090442) Period of Study: 1993-2000 Location: Atlanta, GA	ED Visits (from 31 hospitals) Health Outcome (ICD9): Cardiovascular: IHD (410-414); Dysrhythmia (427); CHF (428); PVCD (433-437, 440, 443, 444, 451-453) Study Design: Case-crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All Sample Description: 4,407,535 visits	Averaging Time: 1-h Mean (SD) unit: 1.8 ppm Range (SD): SD: 1.2 Copollutant: NR	Increment: 1.2 ppm OR Estimate [Lower CI, Upper CI] Lags examined (days): 0-2ma IHD: Without Diabetes: 1.023 (1.004-1.420) Without CHF: 1.024 (1.006-1.042) Dysrhythmias: With Hypertension: 1.065 (1.015-1.118) PVCD: With Hypertension: 1.038 (1.004-1.074) Without Hypertension: 1.027 (1.002-1.054) With Diabetes: 1.065 (1.012-1.121) Without Diabetes: 1.025 (1.003-1.048) With COPD: 1.113 (1.027-1.205) Without COPD: 1.026 (1.004-1.047) Without CHF: 1.029 (1.008-1.051) With Dysrhythmias: 1.072 (1.011-1.138) Without Dysrhythmias: 1.026 (1.004-1.048) CHF: With COPD: 1.058 (1.003-1.115)
Author: Slaughter et al. (2005, 073854) Period of Study: 1995-2001 Location: Spokane, WA	Health Outcome (ICD9: Cardiac Hospital Admissions: (390-459) Study Design: Time series Statistical Analyses: Poisson regression (GLM & GAM) Age Groups Analyzed: All Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: 0.42-1.82 Range (Min, Max): NR Copollutant correlation: PM_{10} : r = 0.32 $PM_{2.5}$: r = 0.62	Increment: NR RR Estimate [Lower CI, Upper CI] ; lag: Lags examined (days): 1, 2, 3 No significant association. Results not reported.
Author: Tolbert et al. (2007, 090316) Period of Study: 1993-2004 Location: Atlanta, GA	ED Visits (from 41 hospitals) Health Outcome (ICD9): IHD (410-414), cardiac dysrhythmias (427), CHF (428), peripheral vascular and cerebrovascular diseases (433-437, 440, 443-445 and 451-453) Study Design: Time series Statistical Analyses: Poisson generalized linear model Age Groups Analyzed: NR Sample Description: 10,234,490 ED Visits (238,360 CVD group)	Averaging Time: 1 h Mean (SD) unit: 1.6 ppm Range (Min, Max): 0.1, 7.7 Copollutant: PM_{10} : r = 0.51 NO_2 : r = 0.70 SO_2 : r = 0.28 O_3 : r = 0.27 $PM_{2.5}$: r = 0.47	Increment: NR RR Estimate [Lower CI, Upper CI] Lags examined (days): 1, 2, 3 Single-Pollutant Model 3-day ma: 1.020 (1.010, 1.030) Results for multi-pollutant models presented graphically

Study	Design	Concentrations	CO Effect Estimates (95% CI)
<p>Author: Yang et al. (2004, 094376)</p> <p>Period of Study: 1997-2000</p> <p>Location: Kaohsiung City, Taiwan</p>	<p>Health Outcome (ICD9): CVDs (410-429)</p> <p>Study Design: Case-crossover</p> <p>Statistical Analyses: Conditional logistic regression</p> <p>Age Groups Analyzed: All</p> <p>Sample Description: 29,661 Cardiovascular hospital admissions (63 hospitals)</p>	<p>Averaging Time: 24 h</p> <p>Mean (SD) unit: 0.79 ppm</p> <p>Range (Min, Max): 0.24, 1.72</p> <p>Copollutant: NR</p>	<p>Increment: 0.28 ppm</p> <p>OR Estimate [Lower CI, Upper CI]</p> <p>Lag examined (days): 0-2 $\geq 25^{\circ}\text{C}$: 1.264 (1.205-1.326) $<25^{\circ}\text{C}$: 1.448 (1.357-1.545)</p> <p>Adjusted for PM_{10}: $\geq 25^{\circ}\text{C}$: 1.206 (1.146-1.270) $<25^{\circ}\text{C}$: 1.314 (1.213-1.423)</p> <p>Adjusted for SO_2: $\geq 25^{\circ}\text{C}$: 1.406 (1.327-1.489) $<25^{\circ}\text{C}$: 1.3450 (1.352-1.555)</p> <p>Adjusted for NO_2: $\geq 25^{\circ}\text{C}$: 1.246 (1.166-1.332) $<25^{\circ}\text{C}$: 0.905 (0.819-0.999)</p> <p>Adjusted for O_3: $\geq 25^{\circ}\text{C}$: 1.250 (1.191-1.311) $<25^{\circ}\text{C}$: 1.447 (1.356-1.545)</p>

Table C-3. Studies of CO exposure and neonatal and postneonatal outcomes.

Study	Design	Concentrations	CO Effect Estimates (95% CI)
<p>Author: Bell et al. (2007, 091059)</p> <p>Period of Study: 1999-2002</p> <p>Location: Connecticut and Massachusetts</p>	<p>Health Outcome: Birth weight and LBW</p> <p>Study Design: Retrospective cohort</p> <p>Statistical Analyses: Linear and logistic regression</p> <p>Age Groups Analyzed: NA</p> <p>Sample Description: 358,504 full-term live singleton births (32-44 wk)</p>	<p>Averaging Time: 24 h</p> <p>Mean (SD) unit: 0.65 ppm (0.18)</p> <p>Range (Min, Max): NR</p> <p>Copollutant: NR</p>	<p>Increment: Interquartile range – 0.30 ppm</p> <p>Regression co-efficient for birth weight (g) [Lower CI, Upper CI]</p> <p>Entire pregnancy: -16.2 (-19.7 to -12.6) Stratified by race. Black mother: -10.9 (-20.2 to -1.6) White mother: -17.5 (-21.3 to -13.7)</p> <p>OR for LBW [Lower CI, Upper CI]</p> <p>Entire pregnancy: 1.028 (0.983-1.074)</p>
<p>Author: Brauer et al. (2008, 156292)</p> <p>Period of Study: 1999-2004</p> <p>Location: Vancouver, Canada</p>	<p>Health Outcome: LBW, PTB and SGA</p> <p>Study Design: Retrospective cohort</p> <p>Statistical Analyses: Logistic regression</p> <p>Age Groups Analyzed: NA</p> <p>Sample Description: 70,249 live singleton births</p>	<p>Averaging Time: LUR model</p> <p>Mean (SD) unit: 633 $\mu\text{g}/\text{m}^3$</p> <p>Range (Min, Max): 124, 1409</p> <p>Copollutant: correlation: PM_{10}: $r = 0.73$ NO_2: $r = 0.75$ SO_2: $r = 0.82$ O_3: $r = -0.39$</p>	<p>Increment: 100 $\mu\text{g}/\text{m}^3$</p> <p>OR for SGA [Lower CI, Upper CI] ;</p> <p>Entire pregnancy: 1.06 (1.03-1.08)</p> <p>OR for term LBW [Lower CI, Upper CI] ;</p> <p>Entire pregnancy: 1.02 (0.96-1.09)</p> <p>OR PTB [Lower CI, Upper CI] ;</p> <p>Entire pregnancy: 1.16 (1.01-1.33)</p>
<p>Author: Chen et al. (2002, 024945)</p> <p>Period of Study: 1991-1999</p> <p>Location: Northern Nevada</p>	<p>Health Outcome: Birth weight & LBW</p> <p>Study Design: Retrospective cohort</p> <p>Statistical Analyses: Linear and logistic regression</p> <p>Age Groups Analyzed: NA</p> <p>Sample Description: 39,338 full term live singleton births (37-44 wk)</p>	<p>Averaging Time: 8 h</p> <p>Mean (SD) unit: 0.98 ppm</p> <p>Range (Min, Max): 0.25, 4.87</p> <p>Copollutant: NR</p>	<p>Increment: NR</p> <p>Regression co-efficient for birth weight (g) [SE]</p> <p>Trimesters: First: -1.02 (6.68) Second: -0.07 (6.58) Third: -3.95 (6.76) Entire pregnancy: -8.28 (14.9)</p> <p>Notes: CO not associated with LBW</p>

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Conceicao et al. (2001, 016628) Period of Study: 1994-1997 Location: Sao Paulo, Brazil	Health Outcome: Child mortality, under 5 yr of age Study Design: Time series Statistical Analyses: Poisson regression (GAM) Age Groups Analyzed: NA Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: 4.4 ppm (2.2) Range (Min, Max): NR Copollutant: NR	Increment: NR Regression co-efficient for Child mortality – under 5 yr of age [SE] ; Lags examined: 0, 1, 2, 3 Lag 2: 0.0306 (0.0076) ($p < 0.01$) Lag chosen for best fitting model
Author: Gilboa et al. (2005, 087892) Period of Study: 1997-2000 Location: Texas	Health Outcome: Birth defects (heart defects and orofacial clefts) Study Design: Case control Statistical Analyses: Conditional Logistic regression Age Groups Analyzed: NA Sample Description: NR	Averaging Time: NR Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Increment: Exposure categories (ppm):<0.4; 0.4 – 0.5; 0.5 – 0.7; >0.7 OR for Birth Defects [Lower CI, Upper CI] ; Exposure period: wk 3 to 8 of pregnancy Conotruncal defects: 1.00; 1.38 (0.97-1.97); 1.17 (0.81-1.70); 1.46 (1.03-2.08) Tetralogy of Fallot: 1.00; 0.92 (0.52-1.62); 1.27 (0.75-2.14); 2.04 (1.26-3.29)
			Notes: CO was not associated with the following defects: Aortic artery and valve, atrial septal, pulmonary artery and valve, ventricular septal, endocardial cushion and mitral valve , cleft lip, cleft palate, aortic valve stenosis, coarctation of the aorta, ostium secundum.
Author: Gouveia et al. (2004, 055613) Period of Study: 1997 Location: Sao Paulo, Brazil	Health Outcome: Birth weight & LBW Study Design: Retrospective cohort Statistical Analyses: Linear and logistic regression Age Groups Analyzed: NA Sample Description: 179,460 live singleton term births (>37 wk)	Averaging Time: 8 h Mean (SD) unit: 3.7 ppm Range (Min, Max): 1.1, 11.4 Copollutant: NR	Increment: 1 ppm Regression co-efficient for birth weight (g) [Lower CI, Upper CI] Trimesters: First: -23.1 (-41.3 to -4.9) Second: 3.2 (-18.2 to 24.5) Third: 1.9 (-18.2 to 22.0) OR for LBW) [Lower CI, Upper CI] 4th quartile exposure (compared to lowest quartile): First: 1.02 (0.82-1.27); Second: 1.07 (0.88-1.30); Third: 0.93 (0.76-1.12)
Author: Ha et al. (2001, 019390) Period of Study: 1996-1997 Location: Seoul, South Korea	Health Outcome: LBW Study Design: Retrospective cohort Statistical Analyses: Logistic regression (GAM) Age Groups Analyzed: NA Sample Description: 276 763 full-term live singleton births (>37 wk)	Averaging Time: 24 h Mean (SD) unit: NR Range (Min, Max): Percentiles: 25th: 0.99 ppm 75th: 1.41 ppm Copollutant correlation: TSP: $r = 0.73$ NO_2 : $r = 0.75$ SO_2 : $r = 0.82$ O_3 : $r = -0.39$	Increment: 0.42 ppm RR for LBW [Lower CI, Upper CI] Trimesters: First: 1.08 (1.04, 1.12) Third: 0.91 (0.87, 0.96) OR for LBW) [Lower CI, Upper CI]
Author: Ha et al. (2003, 042552) Period of Study: 1995-1999 Location: Seoul, South Korea	Health Outcome: Post-neonatal mortality (1 mo-1 yr) (also looked at older age groups) Study Design: Time series Statistical Analyses: Poisson regression (GAM) Age Groups Analyzed: NA Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: 1.2 ppm Range (Min, Max): 0.39, 3.38 Copollutant correlation: PM_{10} : $r = 0.63$ NO_2 : $r = 0.72$ SO_2 : $r = 0.75$ O_3 : $r = -0.46$	Increment: 0.57 ppm RR for Post-neonatal mortality (1 mo-1 yr) [Lower CI, Upper CI] Lags examined: 0 Total mortality: Lag 0: 1.020 (0.976-1.067) Respiratory mortality: Lag 0: 1.388 (1.009-1.911)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Hajat et al. (2007, 093276) Period of Study: NR Location: Birmingham, Bristol, Leeds, Liverpool, London, Manchester, Middlesbrough, Newcastle, Nottingham, Sheffield England	Health Outcome: Neonatal and postneonatal mortality Study Design: Time series Statistical Analyses: Poisson regression (GLM) Age Groups Analyzed: NA Sample Description: 22,288 total infant deaths between 1990 and 2000	Averaging Time: 3 days Mean (SD) unit: (mg/m ³) Birmingham: 0.64; Bristol: 1.01; Leeds: 0.73; Liverpool: 0.51; London: 0.77; Manchester: 0.63; Middlesbrough: 0.37; Newcastle: 0.67; Nottingham: 0.62; Sheffield: 0.60 Range (Min, Max): Birmingham: 0.4, 0.8; Bristol: 0.6, 1.2; Leeds: 0.5, 0.9; Liverpool: 0.3, 0.6; London: 0.5, 0.9; Manchester: 0.4, 0.7; Middlesbrough: 0.2, 0.4; Newcastle: 0.5, 0.8; Nottingham: 0.4, 0.7; Sheffield: 0.3, 0.7 Copollutant: SO ₂ , NO ₂ , NO, O ₃ , PM ₁₀	Increment: 1 mg/m ³ RR Estimate [Lower CI, Upper CI] Lags examined (days): 0, 1, 2 All infant deaths: 1.02 (0.96, 1.09) Neonatal deaths: 0.99 (0.92, 1.07) Post-neonatal deaths: 1.09 (0.94, 1.25) City-specific results of all infant mortality displayed graphically
Author: Huynh et al. (2006, 091240) Period of Study: 1999-2000 Location: California	Health Outcome: PTB (24-36 wk gestation) Study Design: Case-control Statistical Analyses: Conditional Logistic regression Age Groups Analyzed: Cases = 24- to 36-wk gestation; Controls = 39- to 44-wk Sample Description: 10,673 PTBs (cases); 32,119 term births (controls)	Averaging Time: NR Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Increment: 1 ppm Exposure level – Quartiles of exposure for first mo and last two wk of gestation (mg/m ³) First: <0.61; Second: 0.61 – 0.82; Third: 0.82 – 1.07; Fourth: >1.07 Quartiles for entire pregnancy and last two wk of pregnancy were similar. OR for PTB [Lower CI, Upper CI] First mo of gestation: Per 1 ppm increase: 1.10 (0.99-1.20) Second quartile: 0.94 (0.88-1.01) Third quartile: 1.04 (0.97-1.11) Fourth quartile: 1.05 (0.96-1.14) Last two wk of gestation: Per 1 ppm increase: 1.00 (0.93-1.09) Second quartile: 1.03 (0.97-1.10) Third quartile: 1.04 (0.97-1.12) Fourth quartile: 0.99 (0.91-1.08) Entire pregnancy: Per 1 ppm increase: 1.06 (0.95-1.18) Second quartile: 0.97 (0.91-1.04) Third quartile: 0.99 (0.92-1.05) Fourth quartile: 1.02 (0.94-1.09) Lowest quartile used as reference group
Author: Hwang and Jaakkola (2008, 193794) Period of Study: 2001-2003 Location: Taiwan	Health Outcome: Oral clefts (with or without palate) Study Design: Case control Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: 6,530 cases from 721,289 newborns	Averaging Time: 8 h Mean (SD) unit: 0.69 (0.4) Range (Min, Max): 0.25, 2.7 Copollutant correlation: PM ₁₀ : r = -0.19 NO _x : r = 0.82 SO ₂ : r = 0.24 O ₃ : r = -0.19	Increment: 100 ppb RR for oral cleft [Lower CI, Upper CI] Month 1: 1.00 (0.96-1.04) Month 2: 1.00 (0.96-1.03) Month 3: 1.00 (0.96-1.03)
Author: Jalaludin et al. (2007, 156601) Period of Study: 1998-2000 Location: Sydney, Australia	Health Outcome: PTB Study Design: Retrospective cohort Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: 123,840 full term live singleton births (<42 wk)	Averaging Time: 8 h Mean (SD) unit: 0.9 ppm (0.68) Range (Min, Max): NR Copollutant correlation: PM ₁₀ : r = 0.28 NO ₂ : r = 0.60 SO ₂ : r = 0.24 O ₃ : r = -0.21	Increment: 1 ppm RR for PTB [Lower CI, Upper CI] First mo: All of Sydney: 0.89 (0.84-0.95) Within 5km of site: 1.03 (0.68-1.54) First trimester: All of Sydney: 0.77 (0.71-0.83) Within 5km of site: 1.24 (0.81-1.91) 1 mo prior to birth: All of Sydney: 0.96 (0.88-1.04) Within 5km of site: 1.00 (0.86-1.15) 3 mo prior to birth: All of Sydney: 0.99 (0.90-1.09) Within 5km of site: 1.11 (0.94-1.31)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Lee et al. (2003, 043202) Period of Study: 1996-1998 Location: Seoul, South Korea	Health Outcome: LBW Study Design: Retrospective cohort Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: 388,105 full-term live singleton births (37-44 wk)	Averaging Time: 24 h Mean (SD) unit: 1.2 ppm Range (Min, Max): 0.4, 3.4 Copollutant correlation: PM ₁₀ : r = 0.47 NO ₂ : r = 0.77 SO ₂ : r = 0.79	Increment: 0.5 ppm OR for LBW [Lower CI, Upper CI] First: 1.04 (1.01-1.07) Second: 1.03 (1.00-1.06) Third: 0.96 (0.93-0.99) Entire pregnancy: 1.05 (1.01-1.09)
Author: Leem et al. (2006, 089828) Period of Study: 2001-2002 Location: Incheon, Korea	Health Outcome: PTB Study Design: Retrospective cohort Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: 52,113 live singleton births	Averaging Time: Kriging was used to estimate exposure Mean (SD) unit: NR Range (Min, Max): NR Copollutant correlation: PM ₁₀ : r = 0.27 NO ₂ : r = 0.63 SO ₂ : r = 0.31	Increment: Exposure level – Quartiles of exposure for first trimester (mg/m ³) First: 0.47-0.63; Second: 0.6 -0.77; Third: 0.78-0.90; Fourth: 0.91-1.27 - exposure groups for third trimester was similar OR for PTB [Lower CI, Upper CI] First Trimester: Second quartile: 0.92 (0.81-1.05) Third quartile: 1.14 (1.01-1.29) Fourth quartile: 1.26 (1.11-1.44) Third Trimester: Second quartile: 1.07 (0.95-1.21) Third quartile: 1.07 (0.94-1.22) Fourth quartile: 1.16 (1.01-1.34) Lowest quartile used as reference group.
Author: Lin et al. (2004, 095787) Period of Study: 1998-2000 Location: Sao Paulo, Brazil	Health Outcome: Neonatal death (within first 28 days of life) Study Design: Time series Statistical Analyses: Poisson regression (GAM) Age Groups Analyzed: NA Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: 2.83 ppm Range (Min, Max): 0.54, 10.25 Copollutant correlation: PM ₁₀ : r = 0.71 NO ₂ : r = 0.67 SO ₂ : r = 0.55 O ₃ : r = 0.03	Increment: NR Regression coefficient for neonatal death [SE] Lags examined: 0 Lag 0: 0.0061 (0.0110)
Author: Lin et al. (2004, 089503) Period of Study: 1995-1997 Location: Taipei & Kaoshiung, Taiwan	Health Outcome: LBW Study Design: Retrospective cohort Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: 92,288 full-term live singleton births (>37 wk) within 3 km of monitoring site.	Averaging Time: 24 h Mean (SD) unit: Taipei (avg over 5 sites) 0.84-1.31 Kaohsiung (avg over 5 sites) 5.56-10.05 Range (Min, Max): NR Copollutant: NR	Increment: Exposure groups M = Median exposure 1.1-14.2 ppm H = High exposure >14.2 ppm OR for LBW [Lower CI, Upper CI] Trimesters: First: M 1.01 (0.89, 1.16), H 0.90 (0.75, 1.09) Second: M 1.02 (0.90, 1.16), H 1.00 (0.82, 1.22) Third: M 0.88 (0.77, 1.00), H 0.86 (0.71, 1.03) Entire pregnancy: M 0.89 (0.77, 1.01), H 0.77 (0.63, 0.94) Notes: Cut off for exposures groups for second and third trimester were similar to those presented above.

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Liu et al. (2003, 089548) Period of Study: 1985-1998 Location: Vancouver, BC, Canada	Health Outcome: PTB, IUGR, LBW Study Design: Retrospective cohort Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: 229,085 live singleton births	Averaging Time: 24 h Mean (SD) unit: 1.0 ppm Range (Min, Max): 25th: 0.7; 75th: 1.2 Copollutant: NR	Increment: 1.0 ppm OR for LBW [Lower CI, Upper CI] Month of pregnancy: First mo: 1.01 (0.93-1.09) Last mo: 0.96 (0.88-1.04) OR for PTB [Lower CI, Upper CI] First mo: 0.95 (0.89-1.01) Last mo: 1.08 (1.01-1.15) OR for IUGR [Lower CI- Upper CI] First mo: 1.06 (1.01-1.10) Last mo: 0.98 (0.94-1.03) Trimester 1: 1.05 (1.00-1.10) Trimester 2: 0.97 (0.92-1.01) Trimester 3: 0.97 (0.93-1.02)
Author: Liu et al. (2007, 090429) Period of Study: 1995-2000 Location: Calgary, Edmonton, and Montreal, Canada	Health Outcome: IUGR Study Design: Retrospective cohort Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: 386,202 live singleton births	Averaging Time: 24 h Mean (SD) unit: 1.1 ppm Range (Min, Max): 25th: 0.6; 75th: 1.3 Copollutant correlation: $\text{PM}_{2.5}$: r = 0.31 NO_2 : r = 0.71 SO_2 : r = 0.21 O_3 : r = -0.42	Increment: 1 ppm RR for LBW [Lower CI, Upper CI] Notes: CO was associated with an increased risk of IUGR of approximately 16% and 23% in the first and nine mo of pregnancy. (All results presented in Figures)
Author: Maisonet et al. (2001, 016624) Period of Study: 1994-1996 Location: Northeastern USA	Health Outcome: Live birth weight Study Design: Retrospective cohort Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: 89,557 live singleton term births (37-44 wk)	Averaging Time: 24 h Mean (SD) unit: NR Range (Min, Max): Percentiles: 25th: 0.93 ppm; 75th: 1.23 ppm Copollutant: NR	Increment: 1 ppm OR for LBW [Lower CI, Upper CI] Trimester: First: 1.08 (0.91-1.28); Second: 1.14 (0.83-1.58); Third: 1.31 (1.06-1.62) Notes: Stratified results among African-Americans: First: 1.43 (1.18-1.74); Second: 1.27 (0.87-1.86); Third: 1.75 (1.50-2.04) Notes: CO had no effect on whites or Hispanics
Author: Mannes et al. (2005, 087895) Period of Study: 1998-2000 Location: Sydney, Australia	Health Outcome: Birth weight and SGA Study Design: Retrospective cohort Statistical Analyses: Linear and logistic regression Age Groups Analyzed: NA Sample Description: 138,056 full-term all singleton births (including stillbirths) (at least 20-wk gestation)	Averaging Time: 8 h Mean (SD) unit: 0.8 ppm Range (Min, Max): 0.0, 4.6 Copollutant: correlation PM_{10} : r = 0.26 NO_2 : r = 0.57 O_3 : r = -0.20	Increment: 1 ppm Regression coefficients for birth weight (g) [Lower CI, Upper CI] All births: First trimester: 1.86 (-8.31 to 12.03) Second trimester: -10.72 (-23.09 to 1.65) Third trimester: -6.63 (-18.57 to 5.31) One mo prior to birth: -15.28 (-25.59 to -4.97) Births within 5 km of monitor: First trimester: -8.56 (-28.60 to 10.68) Second trimester: -28.87 (-50.98 to -6.76) Third trimester: -22.88 (-44.58 to -1.18) One mo prior to birth: -10.41 (-30.03 to 9.21) OR for SGA [Lower CI, Upper CI] All births: First trimester: 0.95 (0.88-1.04) Second trimester: 0.99 (0.90-1.10) Third trimester: 1.01 (0.91-1.11) One mo prior to birth: 1.06 (0.98-1.16) Births within 5km of monitor: First trimester 0.99 (0.86-1.14) Second trimester: 1.06 (0.90-1.25) Third trimester: 1.05 (0.90-1.23) One mo prior to birth: 1.10 (0.96-1.27)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Medeiros et al. (2005, 089824) Period of Study: 1998-2000 Location: Sao Paulo, Brazil	Health Outcome: Birth weight and LBW Study Design: Retrospective cohort Statistical Analyses: Linear and logistic regression Age Groups Analyzed: NA Sample Description: 311,735 full-term live singleton births (37-41 wk)	Averaging Time: 24 h Mean (SD) unit: Daily mean shown in Figure (see paper) Range (Min, Max): NR Copollutant: NR	Increment: 1 ppm Regression coefficient for birth weight (g) [Lower CI, Upper CI] Trimesters: First: -11.9 (-15.5 to -8.2); Second: 4.9 (0.5-9.3); Third: 12.1 (7.6-16.6) OR for LBW [Lower CI, Upper CI] 4th quartile exposure (compared to lowest quartile) First: 0.98 (0.91-1.06); Second: 0.97 (0.90-1.05); Third: 1.03 (0.96-1.11)
Author: Mortimer et al. (2008, 187280) Period of Study: November 2000-April 2005 Location: Central Valley of California	Health Outcome: Allergic sensitization Study Design: Cohort Statistical Analyses: Chi-square tests Age Groups Analyzed: 6-11 yrs. Sample Description: 170 children with asthma from the FACES-LiTE study	Averaging Time: 8 h Mean (SD) unit: NR Range (Min, Max): NR Copollutant: Entire Prenatal: PM ₁₀ : r = 0.32 NO ₂ : r = 0.74 O ₃ : r = -0.40 Trimester 2: PM ₁₀ : r = 0.32 NO ₂ : r = 0.68 O ₃ : r = -0.26	Increment: NR Trimester specific results presented graphically Single-pollutant Model for "sensitized to at least one outdoor allergen" OR adjusted for yr of birth and sex [Lower CI, Upper CI] Entire Pregnancy 24-h avg: 1.45 (1.02, 2.07) Daily max: 1.53 (1.01, 2.33) 8-h max: 1.55 (1.01, 2.37) 2nd Trimester 24-h avg: 1.52 (0.93, 2.47) Daily max: 1.50 (0.92, 2.45) 8-h max: 1.45 (0.90, 2.35) Coefficient adjusted for yr of birth and sex [SE] Entire Pregnancy 24-h avg: 1.33 (0.68) Daily max: 0.54 (0.27) 8-h max: 0.84 (0.42) 2nd Trimester 24-h avg: 0.57 (0.34) Daily max: 0.21 (0.13) 8-h max: 0.32 (0.21)
Author: Parker et al. (2005, 087462) Period of Study: 2000 Location: California	Health Outcome: Birth weight & SGA Study Design: Retrospective cohort Statistical Analyses: Linear and logistic regression Age Groups Analyzed: NA Sample Description: 18,247 full-term live singleton births (40 wk) within 5 mi of a monitor	Averaging Time: 24 h Mean (SD) unit: 0.78 ppm Range (Min, Max): NR Copollutant: NR	Increment: Quartiles of exposure for first trimester First: <0.57; Second: 0.57-0.76 ; Third: 0.76- 0.93; Fourth: >0.93 - exposure groups for other trimesters were similar Regression co-efficient for birth weight (g) [Lower CI, Upper CI] Trimesters: 4th quartile exposure (compared to lowest quartile) First: -7.3 (-29.7 to 15.0); Second: 14.2 (-8.9 to 37.3); Third: -8.4 (-32.2 to 15.3); Entire pregnancy: -20.5 (-40.1 to -0.8) OR for SGA [Lower CI, Upper CI] 4th quartile exposure (compared to lowest quartile) First: 0.91 (0.76-1.09); Second: 0.80 (0.66-0.97); Third: 0.90 (0.75-1.10); Entire pregnancy: 0.95 (0.81-1.12)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Ritz et al. (2000, 012068) Period of Study: 1989-1993 Location: Southern California	Health Outcome: PTB Study Design: Retrospective Cohort Statistical Analyses: Logistic regression Age Groups Analyzed: Eligible study subjects were singletons born at 26- to 44-wk gestation Sample Description: 97,518 neonates born in Southern California	Averaging Time: 6-9 a.m. Mean (SD) unit: 2.70 ppm Range (Min, Max): 0.36, 9.12 Copollutant correlation: PM_{10} : r = 0.37 NO_2 : r = 0.60 O_3 : r = -0.44	Increment: 3 ppm RR for PTB [Lower CI, Upper CI] Adjusted for various risk factors and season of birth and conception 6 wk prior to birth: 1.04 (0.99-1.10) 1st mo of pregnancy: 1.04 (0.99-1.09) Adjusted for various risk factors 6 wk prior to birth: 1.06 (1.02-1.10) 1st mo of pregnancy: 1.01 (0.97-1.04)
Author: Ritz et al. (2002, 023227) Period of Study: 1987-1993 Location: Southern California	Health Outcome: Birth defects (heart defects and orofacial clefts) Study Design: Case control Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: NR	Averaging Time: NR Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Increment: Exposure categories: ppm <1.14; 1.14-1.57; 1.57-2.39; >2.39 OR for Birth defects [Lower CI, Upper CI]: Period of exposure: Second mo of pregnancy. Aortic artery and valve defects: 1.00 (ref group); 1.10 (0.73-1.66); 1.25 (0.74-2.13); 0.93 (0.47-1.85) Pulmonary artery and valve anomalies: 1.00 (ref group); 1.09 (0.69-1.73); 0.92 (0.50-1.70); 1.00 (0.46-2.17) Ventricular septal defects: 1.00 (ref group); 1.62 (1.05-2.48); 2.09 (1.19-3.67); 2.95 (1.44-6.05) Conotruncal defects: 1.00 (ref group); 0.79 (0.47-1.32); 0.73 (0.36-1.47); 0.95 (0.38-2.38)
Author: Ritz et al. (2006, 089819) Period of Study: 1989-2000 Location: Southern California	Health Outcome: Postneonatal mortality (28 days to 1 yr); all causes; SIDS Study Design: Case control Statistical Analyses: Conditional Logistic regression Sample Description: Mothers residing within 16 km of monitoring site	Averaging Time: 24 h Mean (SD) unit: 1.63 ppm Range (Min, Max): 0.38, 3.44 Copollutant: correlation PM_{10} : r = 0.33 NO_2 : r = 0.72 O_3 : r = -0.57	Increment: 1 ppm OR for Post-neonatal death [Lower CI, Upper CI] Exposure period: 2 wk prior to death, 1 mo prior to death, 2 mo prior to death, 6 mo prior to death All causes: 2 wk prior to death: 1.14 (1.03-1.25) 2 mo prior to death: 1.11 (1.06-1.16) SIDS: 2 mo prior to death: 1.19 (1.10-1.28) Term/normal weight births 2 mo prior to death: All causes: 1.12 (1.05-1.19) SIDS: 1.17 (1.07-1.29) Respiratory: 1.14 (0.95-1.36) Preterm &/or LBW births 2 mo prior to death: All causes: 1.12 (1.01-1.25) SIDS: 1.46 (1.09-1.94) Respiratory: 1.03 (0.83-1.27)
			Notes: These results did not persist in multipollutant models (CO, NO_2 , PM_{10} , O_3)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Ritz et al. (2007, 096146) Period of Study: January-December 2003 Location: Los Angeles, CA	Health Outcome: PTB Study Design: Nested case-control Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: A survey of 2,543 of 6,374 women sampled from a cohort of 58,316 eligible births in Los Angeles county.	Averaging Time: 24 h Mean (SD) unit: NR Copollutant correlation: TSP: $r = 0.73$ NO_2 : $r = 0.75$ SO_2 : $r = 0.82$ O_3 : $r = -0.39$	Increment: Exposure categories (ppm): Less than 0.58: 0.59-0.91; 0.92-1.25; >1.25 RR for LBW [Lower CI, Upper CI] First trimester: 1.00 (Ref group); 1.17 (1.08-1.26); 1.15 (1.05-1.26); 1.25 (1.12-1.38) 6 wk prior to birth 1.00 (Ref group); 1.00 (0.93-1.08); 1.08 (0.98-1.20); 1.03 (0.93-1.14) Entire pregnancy: 1.00 (Ref group); 0.76 (0.70-0.82); 0.84 (0.77-0.91); 1.03 (0.91-1.17)
Author: Salam et al. (2005, 087885) Period of Study: 1975-1987 Location: California	Health Outcome: Birth weight, LBW , IUGR Study Design: Retrospective cohort Statistical Analyses: Linear and logistic regression Age Groups Analyzed: NA Sample Description: 3,901 infants from the California Children's Health Study	Averaging Time: 24-h Mean (SD) unit: 1.8 ppm (0.9) (Entire pregnancy) Range: NR Copollutant: correlation PM_{10} : $r = 0.41$ NO_2 : $r = 0.69$ O_3 : $r = -0.27$	Increment: Entire pregnancy 1.2 ppm Trimesters: First: 1.4 ppm; Second: 1.4 ppm; Third: 1.3 ppm Regression co-efficient for birth weight (g) [Lower CI, Upper CI] Trimesters: First: -21.7 (-42.3 to -1.1); Second: 11.3 (-9.7 to 32.3); Third: 11.8 (-8.4 to 32.1); Entire pregnancy: 2.2 (-20.1 to 24.4) OR for LBW [Lower CI, Upper CI] Trimesters: First: 1.0 (0.7-1.5); Second: 0.9 (0.6-1.3); Third: 0.7 (0.5-1.1); Entire pregnancy: 0.8 (0.6-1.3) OR for IUGR [Lower CI, Upper CI] Trimesters: First: 1.2 (1.0-1.4); Second: 1.0 (0.9-1.1); Third: 1.0 (0.8-1.1); Entire pregnancy: 1.0 (0.9-1.2)
Author: Son et al. (2008, 190323) Period of Study: NR Location: Seoul, Korea	Health Outcome: Postneonatal mortality from all causes Study Design: Case crossover and time series Statistical Analyses: Conditional logistic regression Age Groups Analyzed: NA Sample Description: 1,286 first-born birth and infant death records from 1999-2003 (only postneonatal deaths)	Averaging Time: 8 h Mean (SD) unit: 1.01 ppm Range (Min, Max): 0.29, 3.54 Copollutant: PM_{10} , NO_2 , O_3 , SO_2	Increment: NR RR Estimate [Lower CI, Upper CI] Lags examined (days): 0-7 Time Series: 1.323 (1.077, 1.625) Case-crossover(1:6): 1.029 (0.833, 1.271) CLR Analyses using different control selection schemes 1:2: 1.076 (0.839, 1.379) 1:4: 0.981 (0.784, 1.228) 1:6: 1.029 (0.833, 1.271)
Author: Strickland et al. (2009, 190324) Period of Study: NR Location: Atlanta, GA	Health Outcome: Cardiovascular malformations Study Design: Retrospective cohort Statistical Analyses: Poisson GLM Age Groups Analyzed: NA Sample Description: Pregnancies reaching at least 20-wk gestation that were conceived during January 1, 1986-March 12, 2003	Averaging Time: 24-h Mean (SD) unit: By season of conception: March-May: 0.9 ppm June-August: 0.8 ppm Sept.-Nov.: 0.9 ppm Dec.-Feb.: 0.7 ppm Age Groups Analyzed: NA Sample Description: Pregnancies reaching at least 20-wk gestation that were conceived during January 1, 1986-March 12, 2003 Range (IQR): 0.3 Copollutant: PM_{10} (24 h): $r = 0.32$ NO_2 (24 h): $r = 0.41$ O_3 (8 h): $r = 0.07$ SO_2 (24 h): $r = 0.23$	Increment: NR RR Estimate [Lower CI, Upper CI] Atrial septal defect, secundum: 1.16 (0.67, 2.00) Coarctation of the aorta: 1.15 (0.65, 2.06) Hypoplastic left heart syndrome: 0.82 (0.37, 1.84) Patent ductus arteriosus: 1.39 (0.72, 2.68) Pulmonary stenosis, valvar: 0.97 (0.53, 1.75) Tetralogy of Fallot: 1.09 (0.59, 2.00) Transposition of the great arteries: 1.29 (0.58, 2.85) Ventricular septal defect, muscular: 1.08 (0.77, 1.50) Ventricular septal defect, perimembranous: 1.06 (0.67, 1.68) Conotruncal defect: 1.22 (0.81, 1.85) Left ventricular outflow tract defect: 1.09 (0.70, 1.68) Right ventricular outflow tract defects: 0.73 (0.44, 1.22)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Tsai et al. (2006, 090709) Period of Study: 1994-2000 Location: Kaoshiung, Taiwan	Health Outcome: Postneonatal death (27 days-1 yr old) Study Design: Case crossover Statistical Analyses: Poisson regression Age Groups Analyzed: NA Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: 8.27 ppm x10 Range (Min, Max): 2.26, 17.7 Copollutant: NR	Increment: Interquartile range: 0.31 ppm OR for Post-neonatal mortality [Lower CI, Upper CI] Lag examined: 0-2 Lag 0-2: 1.051 (0.304-3.630)
Author: Wilhelm et al. (2005, 088668) Period of Study: 1994-2000 Location: Los Angeles, CA	Health Outcome: Term LBW and PTB Study Design: Retrospective cohort Statistical Analyses: Logistic regression Age Groups Analyzed: NA Sample Description: 518,254 births within 4 mi of a monitoring station. Varied according to analyses.	Averaging Time: 24 h Mean (SD) unit: Trimester 1: 1.42 ppm Results for third trimester and 6 wk prior to birth were similar to first trimester Range (Min, Max): 0.26, 2.82 Copollutant correlation: First Trimester: PM_{10} : r = 0.12 $PM_{2.5}$: r = 0.57 NO_2 : r = 0.81 SO_2 : r = -0.31	Increment: 1 ppm RR for PTB [Lower CI, Upper CI] First trimester: <1 mile: 1.06 (1.00-1.12) 1-2 miles: 1.06 (1.03-1.10) 2-4 miles: 1.08 (1.06-1.09) ZIP code level: 1.04 (1.01-1.07) 6 wk prior to birth: < 1.04 (0.98-1.09) 1-2 miles: .04 (1.01-1.08) 2-4 miles: 1.01 (0.99-1.02) ZIP code level: 1.03 (1.00-1.06) Notes: All results above did not persist in multipollutant model (CO, NO ₂ , O ₃ , PM ₁₀) OR for term LBW [Lower CI, Upper CI] Third trimester: <1 mile: 1.10 (0.98-1.23) 1-2 miles: 1.05 (0.99-1.13) 2-4 miles: 1.06 (1.02-1.10) ZIP code level: 1.12 (1.05-1.19) Notes: All results above did not persist in multipollutant model (CO, NO ₂ , O ₃ , PM ₁₀) See paper for results based on exposure category groupings.
Author: Woodruff et al. (2008, 098386) Period of Study: 1999-2002 Location: U.S. counties with >250,000 residents	Health Outcome: Postneonatal deaths all causes; respiratory; SIDS; ill-defined + SIDS; other causes. Study Design: Retrospective cohort Statistical Analyses: Logistic regression (GEE) Age Groups Analyzed: NA Sample Description: NR	Averaging Time: 24 h Mean (SD) unit: All causes: 0.70 ppm Range (Min, Max): Percentiles: 25th: 0.48; 75th: 0.87 Copollutant correlation: PM_{10} : r = 0.18 SO_2 : r = 0.27 O_3 : r = -0.46	Increment: 0.39 ppm OR for Post-neonatal mortality [Lower CI, Upper CI] Avg exposure over the first 2 mo of life: All causes: 1.01 (0.95-1.07) Respiratory: 1.14 (0.93-1.40) SIDS: 0.88 (0.76-1.03) Ill-defined + SIDS: 0.93 (0.84-1.02) Other causes: 1.02 (0.97-1.07)
Author: Yang et al. (2004, 094376) Period of Study: 1994-2000 Location: Taipei, Taiwan	Health Outcome: Postneonatal mortality (27 days-1 yr old) Study Design: Case crossover Statistical Analyses: Poisson regression Age Groups Analyzed: NA Sample Description: NR	Averaging Time: 24-h Mean (SD) unit: 15.8 ppm x10 Range (Min, Max): 3.20, 48.4 Copollutant: NR	Increment: Interquartile range: 0.56 ppm OR for Post-neonatal mortality [Lower CI, Upper CI] Lag examined: 0-2 Lag 0-2: 1.038 (0.663-1.624)

Table C-4. Studies of short-term CO exposure and respiratory morbidity

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Andersen et al. (2008, 096150) Period of Study: Dec 1998-Dec 2004 Location: Copenhagen, Denmark	Health Outcome: Wheezing symptoms Study Design: Panel Statistical Analyses: Logistic regression (GEE) Age Groups Analyzed: 0-3 yrs Sample Description: 205 children of mothers with asthma	Averaging Time: 24h Mean (SD) unit: 0.29 (0.10) ppm Range (percentiles): 25th = 0.22; 75th = 0.34 Copollutant: correlation PM ₁₀ : r = 0.45 PM _{2.5} : r = 0.45 UFPNC: r = 0.52 NO ₂ : r = 0.75 NO _x : r = 0.74 O ₃ : r = -0.63	Increment: NR OR Estimate [Lower CI, Upper CI] ; lag: Lags examined: 0, 1, 2, 3, 4, 2-4 Lag 0: 0.96 (0.80, 1.15) Lag 1: 0.92 (0.77, 1.10) Lag 2: 1.08 (0.92, 1.28) Lag 3: 1.07 (0.90, 1.26) Lag 4: 1.02 (0.84, 1.23) 3d mean: 1.07 (0.87, 1.32)
Author: Bhattacharyya et al. (2009, 180154) Period of Study: 1997-2006 Location: NR (National Health Interview Survey as aggregated in the Integrated Health Interview Series served as data source)	Health Outcome: Respiratory morbidity Study Design: Cross-sectional study Statistical Analyses: SPSS version 14.0, univariate linear regression analysis Age Groups Analyzed: 18+ yr (avg: 45.2 yr) Sample Description: Hay fever, weak/failing kidneys, sinusitis all in past 12 mo	Averaging Time: NR Mean (SD) unit: NR Range (Min, Max): 2.209-4.157 ppm (decreased with increasing yr) Copollutant: NR	Increment: NR Linear regression analysis for disease condition prevalence: Hayfever: Standardized B- 0.012, p-value- <0.001; Sinusitis: Standardized B- 0.027, p-value- <0.001; Kidney Weak/Failin: Standardized B- -0.001, p-value- <0.001 Lags examined: NR
Author: Chen et al. (1999, 011149) Period of Study: 5/1995-1/1996 Location: 3 Taiwan communities	Health Outcome: Lung function (FVC, FEV ₁ , FEV ₁ /FVC, FEF _{25-75%} , PEF) Study Design: Cross-sectional survey Statistical Analyses: Multivariate linear model Population: 941 children (Boys: 453; Girls: 488) Age Groups Analyzed: 8-13 yr	Pollutant: CO Averaging Time: 1-h max; 24-h avg Mean (SD) unit: NR Range (Min, Max): 1-h max: (0.4, 3.6) Copollutant correlation: NO ₂ : r = 0.86 – 0.98 Note: To represent the schoolchildren's exposure the daytime avg and peak concentrations were measured from 0800 to 1800.	Increment: NR β Coefficient (SE); lag: FVC (mL) 24-h avg -66.6 (40.73); 1 -147.71 (64.48); 2 2.2 (48.13); 7 1-h max -33.25 (20.74); 1 -16.48 (19.67); 2 -5.18 (16.48); 7 FEV ₁ (mL) 24-h avg 20.55 (38.24); 1 -82.42 (60.95); 2 48.23 (45.58); 7 1-h max 1.2 (19.48); 1 -1.44 (18.57); 2 20.96 (15.67); 7
Author: Chen et al. (2000, 011931) Period of Study: 8/1996-6/1998 Location: Washoe County, NV	Health Outcome: School absenteeism Study Design: Time series Statistical Analyses: Maximum likelihood Population: 1st to 6th grade children: 27,793 Age Groups Analyzed: 1st to 6th grade children	Pollutant: CO Averaging Time: 1-h max Mean (SD) unit: 2.73 (1.154) ppm Range (Min, Max): (0.65, 2.73) Copollutant correlation: PM ₁₀ : r = 0.721 O ₃ : r = -0.204	Increment: 1.0 ppm % Increase (Lower CI, Upper CI); lag: 3.79% (1.04-6.55); 0

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: de Hartog et al. (2003, 001061)	Health Outcome: Respiratory symptoms (shortness of breath, being awakened by breathing problems, phlegm, wheezing, tripping heart) Period of Study: 1998-1999 Location: Amsterdam, Netherlands; Erfurt, Germany; Helsinki, Finland Population: Nonsmoking individuals with CHD: Amsterdam: 37 Erfurt: 47 Helsinki: 47 Age Groups Analyzed: ≥ 50 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Amsterdam: 0.6 mg/m ³ Erfurt: 0.4 mg/m ³ Helsinki: 0.4 mg/m ³ Range (Min, Max): Amsterdam: (0.4, 1.6) Erfurt: (0.1, 2.5) Helsinki: (0.1, 1.0) Copollutant: PM _{2.5} : NO ₂	Increment: 0.25 mg/m ³ Odds Ratio (Lower CI, Upper CI); lag: Incidence of symptoms Shortness of breath 1 (0.92-1.1); 0 0.96 (0.88-1.05); 1 1 (0.92-1.09); 2 1.07 (0.98-1.16); 3 1.03 (0.9-1.18); 0-4 Being awakened by breathing problems 1.02 (0.92-1.14); 1 1.03 (0.93-1.15); 2 1.11 (1-1.22); 3 1.16 (0.98-1.37); 0-4 Phlegm 1.05 (0.93-1.19); 0 1.02 (0.91-1.14); 1 1.08 (0.96-1.22); 2 1.09 (0.97-1.22); 3 1.13 (0.94-1.35); 0-4 Prevalence of symptoms Shortness of breath 1 (0.94-1.06); 0 0.99 (0.94-1.05); 1 0.99 (0.93-1.05); 2 1.01 (0.95-1.07); 3 0.98 (0.9-1.07); 0-4 Being awakened by breathing problems 1.01 (0.93-1.1); 1 0.99 (0.91-1.08); 2 1.1 (1.02-1.19); 3 1.13 (1-1.29); 0-4
Author: Delfino et al. (2003, 050460)	Health Outcome: Asthma symptoms (Cough, wheeze, sputum production, shortness of breath, chest tightness) (symptom scores >1, symptom scores >2); Lung function (PEF) Period of Study: 11/1999-1/2000 Location: Los Angeles, CA Study Design: Panel study Statistical Analyses: Asthma symptoms: GEE Lung function: Generalized linear mixed model Population: 22 asthmatic Hispanic children Age Groups Analyzed: 10-15 yr	Pollutant: CO Averaging Time: 1-h max; 8-h max Mean (SD) unit: 1-h max: 7.7 (3.1) ppb 8-h max: 5.0 (2.0) ppb Range (Min, Max): 1-h max: (2, 17) 8-h max: (1, 10) Copollutant correlation: NO ₂ : r = 0.65; O ₃ : r = -0.17; Acetaldehyde: r = 0.51; Acetone: r = 0.28; Formaldehyde: r = 0.41; Benzene: r = 0.50; Ethylbenzene: r = 0.62; Tetrachloroethylene: r = 0.63; Toluene: r = 0.71; m,p - Xylene: r = 0.72; PM ₁₀ : r = 0.50; EC: r = 0.60; OC: r = 0.55; SO ₂ : r = 0.69	Increment: 5.0 ppb & 3.0 ppb Odds Ratio (Lower CI, Upper CI); lag: 1-max Increment: 5.0 ppb Symptom scores >1 0.95 (0.52-1.75); 0 1.11 (0.75-1.65); 1 Symptom scores >2 0.48 (0.07-3.53); 0 .28 (0.53-3.12); 1 8-h max Increment: 3.0 ppb Symptom scores >1 0.95 (0.55-1.62); 0 1.2 (0.77-1.86); 1 Symptom scores >2 0.53 (0.10-2.92); 0 1.43 (0.41-5.00); 1
Author: Estrella et al. (2005, 099124)	Health Outcome: Acute respiratory infection Period of Study: 1/2000-4/2000 Location: Quito, Ecuador Study Design: Prospective study Statistical Analyses: Logistic regression; Poisson Population: 960 children Age Groups Analyzed: 6-11 yr	Pollutant: CO Averaging Time: NR Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Increment: NR Odds Ratio (Lower CI, Upper CI); lag: Acute respiratory infection ARI in children COHb >2.5% vs. COHb <2.5%: Adjusted Logistic Regression Model 3.25 (1.65-6.38) ARI in children COHb >2.5% vs. COHb <2.5%: Crude Logistic Regression Model 2.06 (1.30-3.20) Log-Linear Model (Each Percent Increase in COHb above 2.5%) 1.15 (1.03-1.28)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Fischer et al. (2002, 025731) Period of Study: NR Location: Utrecht, Netherlands	Health Outcome: Lung function (FVC, FEV ₁ , PEF, MMF) Study Design: Panel study Statistical Analyses: Restricted max likelihood linear model Population: 68 children Age Groups Analyzed: 10-11	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 921 µg/m ³ Range (Min, Max): (319, 1540) Copollutant: PM ₁₀ ; BS; NO ₂ ; NO	Increment: 100 µg/m ³ mL (SE); lag: FVC: 0.5 (0.4); 1; 0.1 (0.2); 2 FEV ₁ : -0.4 (0.5); 1; -0.2 (0.2); 2 m/s (SE); lag: PEF: -1.1 (2.8); 1; -0.6 (1.1); 2 MMF: -0.5 (1.4); 1; -0.3 (0.6); 2
Author: Ho et al. (2007, 093265) Period of Study: Oct 1995-Mar 1996 Location: Taipei, Taiwan	Health Outcome: Asthma Study Design: Panel Statistical Analyses: Logistic regression (GEE) Age Groups Analyzed: 10-17 yr Sample Description: A stratified cluster random sample of students (n=69,367) from 1,139,452 students sampled nationwide	Averaging Time: 8 h Mean (SD) unit: NR Range (min, max): NR Copollutant: NO, NO ₂ , NO _x , O ₃ , SO ₂ , PM ₁₀ , PSI	Increment: very high, high, med, low, very low OR Estimate [Lower CI, Upper CI]; lag: Lags examined: NR Females: 1.984 (1.536, 2.561) Males: 1.780 (1.377, 2.302) Monthly attack rate vs single air pollutant concentrations Estimate (p-value): 0.0750 (0.3336)
Author: Lagorio et al. (2006, 089800) Period of Study: 5/1999-6/1999; 11/1999-12/1999 Location: Rome, Italy	Health Outcome: Lung function (FVC, FEV ₁) Study Design: Time-series panel study Statistical Analyses: Generalized estimating equations (GEE) Population: COPD panel: 11 Asthma panel: 11 IHD panel: 7 Age Groups Analyzed: COPD panel: 50-80 yr Asthma panel: 18-64 yr IHD panel: 40-64 yr Notes: Asthma panel was restricted to never smokers, while COPD and IHD panels include former smokers if smoking cessation occurred at least 1 yr prior to enrollment.	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Overall: 7.4 (6.2) mg/m ³ Spring: 2.1 (0.3) mg/m ³ Winter: 12.3 (4.9) mg/m ³ Range (Min, Max): Overall: (1.6, 28.9) Copollutant correlation: PM _{2.5} : r = 0.67 PM _{10-2.5} : r = -0.09 PM ₁₀ : r = 0.55 NO ₂ : r = 0.05 O ₃ : r = -0.87 SO ₂ : r = 0.65	Increment: 1 mg/m ³ β Coefficient (SE); lag: COPD panel FVC (% of predicted) -0.14 (0.15); 0 -0.13 (0.18); 0-1 0.15 (0.23); 0-2 FEV1 (% of predicted) -0.05 (0.13); 0 -0.12 (0.16); 0-1 -0.03 (0.2); 0-2 Asthma panel FVC (% predicted) 0.02 (0.12); 0 -0.001 (0.13); 0-1 -0.06 (0.16); 0-2 FEV1 (% of predicted) -0.05 (0.14); 0 -0.16 (0.15); 0-1 -0.28 (0.18); 0-2 IHD panel FVC (% of predicted) 0.176 (0.101); 0 0.132 (0.120); 0-1/ 0.132 (0.165); 0-2 FEV1 (% of predicted) 0.204 (0.120); 0 0.114 (0.142); 0-1 0.159 (0.194); 0-2
Author: Moon et al. (2009, 190297) Period of Study: Apr 2003-May 2003 Location: Seoul, Incheon, Busan, & Jeju, Korea	Health Outcome: Respiratory symptoms Study Design: Panel Statistical Analyses: Logistic regression (GEE) Age Groups Analyzed: < 13 yr Sample Description: 696 children	Averaging Time: 24h Mean (SD) unit: NR IQ Range: 0.12ppm Copollutant: PM ₁₀ , SO ₂ , NO ₂ , O ₃	Increment: 0.12 ppm (IQR) OR Estimate [Lower CI, Upper CI]; lag: Lags examined: lag days 0-3 Lower resp. symptoms: 1.005 (1.003, 1.008), lag 0 Upper resp. symptoms: 1.006 (1.003, 1.008), lag 0-2 Irritation symptoms: 1.004 (1.001, 1.006), lag 1-3

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Mortimer et al. (2008, 187280) Period of Study: Nov 2000-Apr 2005 Location: Fresno, California	Health Outcome: Allergic sensitization Study Design: Panel Statistical Analyses: Multistep modeling Age Groups Analyzed: 6-11 yr Sample Description: 170 children with physician diagnosed asthma	Averaging Time: 24-h avg, 24-h max, 8-h max Mean (SD) unit: NR IQ Range (24-h avg, 24-h max, 8-h max): 0.28, 0.79, 0.52 Copollutant: entire prenatal correlation NO_2 : $r = 0.74$ O_3 : $r = -0.40$ PM_{10} : $r = 0.32$	Increment: IQR OR Estimate [Lower CI, Upper CI]; lag: Lags examined: NR Entire Pregnancy: CO 24-h avg: 1.45 (1.02, 2.07) CO 24-h max: 1.53 (1.01, 2.33) CO 24-h avg: 1.55 (1.01, 2.37)
Author: Nkwocha et al. (2008, 190304) Period of Study: Feb 2005-Jul 2006 Location: Port Harcourt, Nigeria	Health Outcome: Respiratory symptoms Study Design: Panel Statistical Analyses: Mixed Effects models Age Groups Analyzed: 0-5 yr Sample Description: 250 children	Averaging Time: 8 h Mean (SD) unit: NR Range (min, max): 1.3 $\mu\text{g}/\text{m}^3$, 1.83 $\mu\text{g}/\text{m}^3$ Copollutant: NO_2 , SO_2 , PM_{10}	Increment: NR Lags examined: NR R Estimate: Dry season: 0.13 Wet season: 0.25
Author: O'Connor et al. (2008, 156818) Period of Study: Aug 1998-Jul 2001 Location: Boston, MA; the Bronx, NY; Chicago, IL; Dallas, TX; New York, NY; Seattle, WA; Tuscon, AZ	Health Outcome: respiratory symptoms Study Design: panel Statistical Analyses: Mixed Effects Models Age Groups Analyzed: 5-12 yr Sample Description: 861 children with persistent asthma and atopy living in low-income census tracts	Averaging Time: 8 h Mean (SD) unit: NR Range (10th-90th): 872.1 ppb Copollutant: PM_{10} , SO_2 , NO_2 , O_3	Increment: 872.1 ppb Lags examined: NR Change Estimate [Lower CI, Upper CI]: FEV_1 : -0.56 (-1.31, 0.20) PEFR : -0.49 (-1.24, 0.27) Pollution Impact*[Lower CI, Upper CI]: Wheeze-cough: 1.26 (1.03, 1.55) Nighttime asthma: 1.35 (1.07, 1.71) Slow play: 1.28 (1.04, 1.59) OR [Lower CI, Upper CI]: Missed School: 1.08 (0.76, 1.53)
*Coefficients from the negative binomial model and indicate the multiplicative effect per unit change			
Author: Park et al. (2002, 093798) Period of Study: 3/1996-12/1999 Location: Seoul, Korea	Health Outcome: School absenteeism Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Population: ~1,264 children (671 Boys, 593 girls) Age Groups Analyzed: 1st through 6th grade students	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.11 (0.40) ppm Range (Min, Max): (0.39, 2.97) Copollutant correlation: PM_{10} : $r = 0.56$; NO_2 : $r = 0.70$; SO_2 : $r = 0.67$; O_3 : $r = -0.46$	Increment: 0.52 ppm Relative Risk (Lower CI, Upper CI); lag: Total Absences: 0.95 (0.94-0.97); 0 Non-Illness Related Absences: 0.99 (0.96-1.02); 0 Illness-Related Absences: 0.96 (0.94-0.98); 0
Author: Park et al. (2005, 088673) Period of Study: 3/2002-6/2002 Location: Incheon, Korea	Health Outcome: Lung function (PEF variability (>20%), Mean PEF); Respiratory symptoms (night respiratory symptoms, cough, inhaler use) Study Design: Panel study Statistical Analyses: GEE; Poisson GAM Population: 64 bronchial asthmatics Age Groups Analyzed: 16-75 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Control days: 0.6368 (0.1522) ppm Dust days: 0.6462 (0.0945) ppm Range (Min, Max): NR Copollutant: NR	Increment: NR Relative Risk (Lower CI, Upper CI); lag: PEF variability (>20%): 1.43 (0.54-3.75) Night respiratory symptoms: 0.98 (0.51-1.86) β Coefficient (SE); lag: PEF variability (>20%): 0.9737 (0.3187) Mean PEF (L/min): -10.103 (2.7146) Night respiratory symptoms: -0.018 (0.3654) Cough: 0.0855 (0.1826) Inhaler Use: 0.0796 (0.1733)

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Penttinen et al. (2001, 030335) Period of Study: 11/1996-4/1997 Location: Helsinki, Finland	Health Outcome: Lung function (PEF) Study Design: Panel study Statistical Analyses: First order autoregressive linear model Population: 57 nonsmoking adult asthmatics Age Groups Analyzed: NR	Pollutant: CO Averaging Time: 24-h avg Median unit: 0.4 mg/m ³ Range (Min, Max): (0.1, 1.1) mg/m ³ Copollutant correlation: PM ₁₀ : r = -0.03 PM _{10-2.5} : r = -0.30 PM _{2.5} : r = 0.32 PM ₁ : r = 0.39 PNC: r = 0.44 NO ₂ 0.01-0.1: r = 0.43 NO ₂ 0.1-1: r = 0.47 NO: r = 0.60 NO ₂ : r = 0.44	Increment: 0.2 mg/m ³ β Coefficient (SE); lag: PEF Deviations (L/min) Morning 0.27 (0.38); 0 -1.08 (0.36); 1 0.23 (0.38); 2 -1.11 (1.19); 5-day avg Afternoon -0.4 (0.43); 0 -0.13 (0.41); 1 -0.71 (0.41); 2 -3.03 (1.06); 5-day avg Evening -0.7 (0.45); 0; -0.31 (0.44); 1 0.3 (0.44); 2 -3.62 (1.19); 5-day avg Co-pollutant models with PNC Morning: -0.67 (0.64); 1 Afternoon: -0.46 (0.69); 0 Evening: -0.46 (0.73); 0
Author: Rabinovitch et al. (2004, 096753) Period of Study: 11/1999-3/2000; 11/2000-3/2001; 11/2001-3/2002 Location: Denver, CO	Health Outcome: Lung function (FEV ₁); asthma exacerbation; bronchodilator use Study Design: Panel study Statistical Analyses: Pulmonary function: Mixed effects model; Asthma exacerbation and medication use: GLM Population: Urban poor asthmatic children: 1999-2000: 41 2000-2001: 63 2001-2002: 43 Age Groups Analyzed: 6-12 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.0 (0.4) ppm Range (Min, Max): (0.3, 3.5) Copollutant: PM _{2.5} ; PM ₁₀ ; NO ₂ ; SO ₂ ; O ₃	Increment: 0.4 ppm β Coefficient (SE); lag: FEV1 AM: -0.001 (0.008); 3-day ma PM: 0.015 (0.01); 3-day ma Odds Ratio (Lower CI, Upper CI); lag: Asthma exacerbation: 1.012 (0.913-1.123); 3-day ma Bronchodilator use: 1.065 (1.001-1.133); 3-day ma
Author: Ranzi et al. (2004, 089500) Period of Study: 2/1999-5/1999 Location: Emilia-Romagna, Italy	Health Outcome: Lung function; respiratory symptoms, medication use Study Design: Panel study Statistical Analyses: GLM Population: 120 "asthma-like" school children Age Groups Analyzed: 6-11 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Urban area: 1.54 mg Rural area: 1.22 mg Range (Min, Max): NR Copollutant: NO ₂ ; TSP; PM _{2.5}	The study did not present quantitative results for CO.
Author: Rodriguez et al. (2007, 092842) Period of Study: 1996-2003 Location: Perth, Australia	Health Outcome: Respiratory symptoms (body temperature, cough, wheeze/rattle chest, runny/blocked nose) Study Design: Panel study Statistical Analyses: Logistic regression, GEE Population: 263 children at high risk of developing asthma Age Groups Analyzed: 0-5 yr	Pollutant: CO Averaging Time: 8-h avg Mean (SD) unit: 1.408 ppm Range (Min, Max): (0.012, 8.031) Copollutant: NR	Increment: NR Odds Ratio (Lower CI, Upper CI); lag: Body Temperature 1.024 (0.911-1.151); 0 1.056 (0.943-1.184); 5 0.991 (0.962-1.021); 0-5 Cough 1.001 (0.996-1.005); 0 1.064 (0.941-1.02); 5 1.028 (0.996-1.061); 0-5 Wheeze/Rattle Chest 1.089 (0.968-1.226); 0 1.136 (1.016-1.26); 5 1.035 (1.005-1.066); 0-5 Runny/Blocked Nose 1.094 (0.824-1.453); 0 1.38 (1.028-1.853); 5 1.101 (1.025-1.183); 0-5

Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: Schildcrout et al. (2006, 089812)	Health Outcome: Asthma symptoms; rescue inhaler use Study Design: Panel study Statistical Analyses: Asthma symptoms: Logistic regression; Rescue Inhaler Use: Poisson regression Population: 990 asthmatic children Age Groups Analyzed: 5-12 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NO_2 ; O_3 ; PM_{10} ; SO_2	Increment: 1.0 ppm Odds Ratio (Lower CI, Upper CI); lag: Asthma Symptoms 1.08 (1.01-1.14); 0 1.07 (0.99-1.16); 1 1.08 (1.02-1.15); 2 1.05 (1.01-1.09); 0-2 + 20 ppb increase in NO_2 1.07 (1-1.14); 0 1.04 (0.96-1.11); 1 1.09 (1.02-1.16); 2 1.04 (1-1.08); 0-2 + 25 $\mu\text{g}/\text{m}^3$ increase in PM_{10} 1.08 (1.01-1.15); 0 1.06 (0.99-1.14); 1 1.08 (1.02-1.14); 2 1.05 (1.01-1.08); 0-2 + 10 ppb increase in SO_2 1.07 (0.99-1.16); 0 1.06 (0.96-1.19); 1 1.1 (1.02-1.18); 2 1.05 (1-1.09); 0-2 Rescue Inhaler Use 1.07 (1.01-1.13); 0 1.05 (0.99-1.1); 1 1.06 (1.01-1.1); 2 1.04 (1.01-1.07); 0-2 Rescue Inhaler Use + 20 ppb increase in NO_2 1.05 (0.99-1.12); 0 1.04 (0.98-1.11); 1 1.07 (1.02-1.12); 2 1.04 (1-1.07); 0-2 + 25 $\mu\text{g}/\text{m}^3$ increase in PM_{10} 1.06 (0.99-1.13); 0 1.05 (0.99-1.11); 1 1.05 (1.01-1.09); 2 1.03 (1-1.07); 0-2 + 10 ppb increase in SO_2 1.04 (0.96-1.12); 0 1.04 (0.97-1.1); 1 1.08 (1.03-1.13); 2 1.04 (1-1.08); 0-2
Author: Silkoff et al. (2005, 087471)	Health Outcome: Lung function (FEV1, PEF); recorded symptoms; rescue medication use Study Design: Panel study Statistical Analyses: Rescue medication use and total symptom score: GEE; Lung function: Mixed effects model Population: 1st winter: 16 with a history of more than 10 pack yr of tobacco use, airflow limitation with FEV1 of less than 70% of predicted value, and FEV1/ FVC ratio of less than 60% 2nd winter: 18 with a history of more than 10 pack yr of tobacco use, airflow limitation with FEV1 of less than 70% of predicted value, and FEV1/ FVC ratio of less than 60% Age Groups Analyzed: ≥ 40 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1999-2000: 1.2 (0.555) ppm 2000-2001: 1.1 (0.5) ppm Range (Min, Max): 1999-2000: (0.340, 3.790) 2000-2001: (0.360, 2.810) Copollutant: NR	The study did not present quantitative results for CO.

Study	Design	Concentrations	CO Effect Estimates (95% CI)																																																
Author: Slaughter et al. (2003, 086294) Period of Study: 12/1994-8/1995 Location: Seattle, WA	Health Outcome: Asthma severity; medication use Study Design: Panel study Statistical Analyses: Ordinal logistic regression; Medication use: Poisson Population: 133 mild-to-moderate asthmatic children Age Groups Analyzed: 5-13 yr	Pollutant: CO Averaging Time: 24-h avg Median unit: 1.47 ppm IQR (25th, 75th): (0.23, 1.87) Copollutant: NR	Increment: Increased asthma attack severity: 0.67 ppm Increased rescue inhaler use: 1.0 ppm Odds Ratio (Lower CI, Upper CI); lag: Increased asthma attack severity: Without transition: 1.21; 1 With transition: 1.17; 1 Increased rescue inhaler use: Without transition: 1.09 (1.03-1.16); 1 With transition: 1.06 (1.01-1.1); 1																																																
Author: Steerenberg et al. (2001, 017157) Period of Study: NR Location: Bilthoven and Utrecht, the Netherlands	Health Outcome: Lung function (PEF); exhaled nitric oxide; inflammatory nasal markers Study Design: Panel study Statistical Analyses: Restricted max likelihood linear model Population: 126 children Age Groups Analyzed: 8-13 yr Notes: The study was only conducted for a two mo period: February and March.	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Utrecht: 0.8 mg/m ³ Bilthoven: 0.5 mg/m ³ Range (Min, Max): Utrecht: (0.3, 2.3) Bilthoven: (0.3, 0.9) Copollutant: NR	The study did not present quantitative results for CO.																																																
Author: Timonen et al. (2002, 025653) Period of Study: 2/1994-4/1994 Location: Kuopio, Finland	Health Outcome: Exercise induced bronchial responsiveness; Lung function (FVC, FEV1, MMEF, AEFV) Study Design: Panel study Statistical Analyses: Linear regression Population: 33 children with chronic respiratory symptoms Age Groups Analyzed: 7-12 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.6 mg/m ³ Range (Min, Max): (0.1, 2.8) Copollutant correlation: PM ₁₀ : r = 0.52 BS: r = 0.80 PNC0.01-0.03: r = 0.81 PNC0.03-0.1: r = 0.87 PNC0.1-0.3: r = 0.71 PNC0.3-1.0: r = 0.60 PNC1.0-3.2: r = 0.84 PNC3.2-10: r = 0.79 NO ₂ : r = 0.85	Increment: 0.32 mg/m ³ β Coefficient (SE); lag: Exercise induced responsiveness <table> <tbody> <tr> <td>ΔFEV₁ (%)</td> <td>FEV₁ (mL)</td> </tr> <tr> <td>-0.081 (0.647); 0</td> <td>19.2 (13.2); 0</td> </tr> <tr> <td>0.03 (0.262); 1</td> <td>-9.04 (5.45); 1</td> </tr> <tr> <td>0.087 (0.26); 2</td> <td>-9.15 (5.21); 2</td> </tr> <tr> <td>-0.091 (0.275); 3</td> <td>-11.7 (5.77); 3</td> </tr> <tr> <td>0.19 (0.599); 0-3</td> <td>-17.5 (12.5); 0-3</td> </tr> <tr> <td>ΔMMEF (%)</td> <td>MMEF (mL/s)</td> </tr> <tr> <td>0.442 (1.79); 0</td> <td>22.2 (36.9); 0</td> </tr> <tr> <td>0.52 (0.723); 1</td> <td>-23 (15.2); 1</td> </tr> <tr> <td>0.313 (0.719); 2</td> <td>-4.63 (14.7); 2</td> </tr> <tr> <td>-0.616 (0.75); 3</td> <td>-30.9 (16); 3</td> </tr> <tr> <td>0.096 (1.64); 0-3</td> <td>-24.9 (34.8); 0-3</td> </tr> <tr> <td>ΔAEFV (%)</td> <td>AEFV (L²/s)</td> </tr> <tr> <td>0.287 (1.19); 0</td> <td>-0.093 (0.088); 0</td> </tr> <tr> <td>0.281 (0.482); 1</td> <td>-0.068 (0.036); 1</td> </tr> <tr> <td>0.904 (0.474); 2</td> <td>-0.06 (0.035); 2</td> </tr> <tr> <td>0.15 (0.483); 3</td> <td>-0.05 (0.039); 3</td> </tr> <tr> <td>1.6 (1.05); 0-3</td> <td>-0.076 (0.083); 0-3</td> </tr> <tr> <td>FVC (mL)</td> <td></td> </tr> <tr> <td>0.064 (10.9); 0</td> <td></td> </tr> <tr> <td>-4.79 (4.51); 1</td> <td></td> </tr> <tr> <td>-9.78 (4.24); 2</td> <td></td> </tr> <tr> <td>-13.9 (4.7); 3</td> <td></td> </tr> <tr> <td>-29.4 (10.1); 0-3</td> <td></td> </tr> </tbody> </table>	ΔFEV ₁ (%)	FEV ₁ (mL)	-0.081 (0.647); 0	19.2 (13.2); 0	0.03 (0.262); 1	-9.04 (5.45); 1	0.087 (0.26); 2	-9.15 (5.21); 2	-0.091 (0.275); 3	-11.7 (5.77); 3	0.19 (0.599); 0-3	-17.5 (12.5); 0-3	ΔMMEF (%)	MMEF (mL/s)	0.442 (1.79); 0	22.2 (36.9); 0	0.52 (0.723); 1	-23 (15.2); 1	0.313 (0.719); 2	-4.63 (14.7); 2	-0.616 (0.75); 3	-30.9 (16); 3	0.096 (1.64); 0-3	-24.9 (34.8); 0-3	ΔAEFV (%)	AEFV (L ² /s)	0.287 (1.19); 0	-0.093 (0.088); 0	0.281 (0.482); 1	-0.068 (0.036); 1	0.904 (0.474); 2	-0.06 (0.035); 2	0.15 (0.483); 3	-0.05 (0.039); 3	1.6 (1.05); 0-3	-0.076 (0.083); 0-3	FVC (mL)		0.064 (10.9); 0		-4.79 (4.51); 1		-9.78 (4.24); 2		-13.9 (4.7); 3		-29.4 (10.1); 0-3	
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Study	Design	Concentrations	CO Effect Estimates (95% CI)
Author: von Klot et al. (2002, 034706) Period of Study: 9/1996-3/1997 Location: Erfurt, Germany	Health Outcome: Asthma symptoms; medication use Study Design: Panel study Statistical Analyses: Logistic regression Population: 53 adults with asthma or asthma symptoms Age Groups Analyzed: 37-77 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.9 mg/m ³ Range (Min, Max): (0.3, 3.0) Copollutant correlation: NC0.01-0.1: r = 0.66 NC0.1-0.5: r = 0.79 NC0.5-2.5: r = 0.46 MC0.1-0.5: r = 0.66 MC0.01-2.5: r = 0.65 PM _{2.5-10} : r = 0.42 PM ₁₀ : r = 0.69 NO ₂ : r = 0.82 SO ₂ : r = 0.32	Increment: 0 and 5-day avg lag: 0.6 mg/m ³ 14-day avg lag: 0.54 mg/m ³ Odds Ratio (Lower CI, Upper CI); lag: Prevalence: Inhaled β2-agonist use 0.98 (0.93-1.03); 0 1.04 (0.97-1.12); 0-4 0.93 (0.86-1.01); 0-13 Prevalence: Inhaled corticosteroid use 1.05 (1.11); 0 1.25 (1.17-1.34); 0-4 1.06 (0.97-1.15); 0-13 Prevalence: Wheezing 1.03 (0.97-1.08); 0 1.13 (1.05-1.22); 0-4 1.14 (1.05-1.25); 0-13 Co-pollutant models Inhaled β2-agonist use CO+MC0.01-2.5: 1 (0.91-1.11); 0-4 CO+NC0.01-0.1: 1.01 (0.91-1.11); 0-4 Inhaled corticosteroid use CO+MC0.01-2.5: 0.89 (0.81-0.98); 0-13 CO+NC: 0.01-0. 1: 0.81 (0.72-0.91); 0-13 Wheezing CO+MC0.01-2.5: 1.15 (1.04-1.27); 0-4 CO+NC0.01-0.1: 1.09 (0.98-1.22); 0-4
Author: Yu et al. (2000, 013254) Period of Study: 11/1993-8/1995 Location: Seattle, Washington	Health Outcome: Asthma symptoms (Wheezing, coughing, chest tightness, shortness of breath) Study Design: Panel study Statistical Analyses: Repeated measures logistic regression models (GEE) Population: 133 mild-to-moderate asthmatics Age Groups Analyzed: 5-13 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.6 ppm Range (Min, Max): (0.65, 4.18) Copollutant correlation: PM ₁₀ : r = 0.82 PM ₁₀ : r = 0.86 SO ₂ : r = 0.31	Increment: 1.0 ppm Odds Ratio (Lower CI, Upper CI); lag: Marginal GEE 1.22 (1.03-1.45); 0 1.3 (1.11-1.52); 1 1.26 (1.09-1.46); 2 Transition GEE 1.18 (1.02-1.37); 0 1.25 (1.1-1.42); 1 1.18 (1.04-1.33); 2

Table C-5. Studies of short-term CO exposure and respiratory hospital admissions and ED visits.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Abe et al. (2009, 190536) Period of Study: January 1-December 31, 2005 Location: Tokyo, Japan	ED Visits Health Outcome: Asthma Study Design: Time-series Statistical Analyses: Bivariate Pearson correlation coefficients, ARIMA model Age Groups Analyzed: Children: ≤14 yr, Adults: ≤ 15 yr Sample Description: Data from daily number of ambulance transports to ED for asthma	Averaging Time: NR Mean (SD) unit: 11.5ppm Range (Min, Max): 3-44ppm Copollutant: NR	Increment: 0.1ppm ARIMA model for ambulance transports to ED for asthma exacerbation among adults: β coefficient: 0.151, SE: 0.098, t statistic: 1.537, P value: .125 ARIMA model for ambulance transports to ED for asthma exacerbation among children: β coefficient: 0.019, SE: 0.034, t statistic: 0.549, P value: 0.583 Lags examined: 0 On the day with the highest CO the number of transports was 25. The number of transports for adults and CO had significant bivariate correlations. The fitted ARIMA model had no significant associations.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Anderson et al. (2001, 017033) Period of Study: 10/1994-12/1996 Location: West Midlands; U.K.	Hospital Admission Health Outcome (ICD9): Respiratory diseases asthma (493) COPD (490-492, 494-496) Study Design: Time series Statistical Analyses: Regression with quasi-likelihood approach and GAM Age Groups Analyzed: All ages 0-14 yr 15-64 yr ≥ 65 yr	Pollutant: CO Averaging Time: Max 8-h avg Mean (SD) unit: 0.8 (0.7) ppm Range (Min, Max): (0.2, 10) Copollutant: correlation PM ₁₀ : r = 0.55; PM _{2.5} : r = 0.54; PM _{2.5-10} : r = 0.10; BS: r = 0.77; SO ₂ : r = 0.17; NO ₂ : r = 0.73; O ₃ : r = -0.29; SO ₂ : r = 0.49	Increment: 1.0 ppm % Increase (Lower CI, Upper CI); lag: Respiratory Diseases Age Group All ages: 0.3% (-1.10 to 1.70); 0-1 0-14: 1.50% (-0.60 to 3.60); 0-1 15-64: -0.70% (-3.60 to 2.30); 0-1 ≥ 65: 0.00% (-2.10 to 2.10); 0-1 Asthma Age Group 0-14: 3.90% (-0.50 to 8.50); 0-1 15-64: -4.90% (-10.60 to 1.10); 0-1 COPD Age Group ≥ 65: 1.00% (-2.50 to 4.60); 0-1
Author: Andersen et al. (2007, 093201) Period of Study: 1/1999-12/2004 Location: Copenhagen, Denmark	Hospital Admission Health Outcome (ICD10): Respiratory diseases: chronic bronchitis (J41-42), emphysema (J43), COPD (J44), asthma (J45), status asthmaticus (j46), pediatric asthma (j45), pediatric asthmaticus (j46) Study Design: Time-series Statistical Analyses: Poisson GAM Age Groups Analyzed: 5-18 yr; ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.3 (0.1) ppm IQR (25th, 75th): (0.22, 0.34) Copollutant; correlation: PM ₁₀ : r = 0.45	Increment: 0.12 ppm Relative Risk (Lower CI, Upper CI); lag: Respiratory Disease Age Group: ≥ 65 CO: 1.024 (0.997-1.053); 0-4 CO, PM ₁₀ : 1.001 (0.961-1.042); 0-4 Asthma Age Group: 5-18 CO: 1.104 (1.018-1.198); 0-5 CO, PM ₁₀ : 1.023 (0.911-1.149); 0-5
Author: Atkinson et al. (1999, 007882) Period of Study: 1/1992-12/1994 Location: London, U.K.	ED Visits Health Outcome (ICD9): Respiratory complaints: wheezing, inhaler request, chest infection, chronic obstructive lung disease (COLD), difficulty breathing, cough, other respiratory complaints. e.g., croup, pleurisy, noisy breathing; Asthma (493) Study Design: Time-series Statistical Analyses: Poisson Age Groups Analyzed: All ages 0-14 yr 15-64 yr ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.8 (0.4) ppm Range (Min, Max): (0.2, 5.6) Copollutant; correlation: NO ₂ O ₃ SO ₂ PM ₁₀ BS	Increment: 0.8 ppm % Increase (Lower CI, Upper CI); lag: Respiratory complaints Age Group All ages: 0.76% (-0.83, 2.38); 1 0-14: 2.92% (0.60, 5.30); 1 15-64: 2.15% (-0.27, 4.63); 1 ≥ 65: 4.29% (1.15, 7.54); 0 Asthma visits: Single-pollutant model Age Group: All ages: 3.32% (0.56, 6.16); 1 0-14: 4.13% (-0.11, 8.54); 0 15-64: 4.41% (0.46, 8.52); 1 Multi-pollutant model Age Group: 0-14 CO, NO ₂ : 2.05% (-2.25, 6.54); 0 CO, O ₃ : 4.48% (0, 9.16); 0 CO, SO ₂ : 2.34% (-1.94, 6.81); 0 CO, PM ₁₀ : 2.93% (-1.53, 7.58); 0 CO, BS: 4.19% (-0.04, 8.60); 0

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Bedeschi et al. (2007, 090712)	ED Visits	Pollutant: CO Health Outcome (ICD9): Asthma (493); Asthma-like disorders, i.e., asthma, bronchiolitis, dyspnea/shortness of breath; Other respiratory disorders (i.e., upper and lower respiratory illness including sinusitis, bronchitis, and pneumonia)	The study did not provide quantitative results for CO.
Period of Study: 1/2001-3/2002		Averaging Time: 24-h avg Mean (SD) unit: 1.4 (0.7) mg/m ³ Range (Min, Max): (0.4, 4.6)	
Location: Reggio Emilia, Italy		Copollutant; correlation: PM ₁₀ : r = 0.61 TSP: r = 0.61 SO ₂ : r = 0.71 NO ₂ : r = 0.77	
	Study Design: Time series		
	Statistical Analyses: Poisson GAM, penalized splines		
	Age Groups Analyzed: <5 yr		
Author: Bell et al. (2008, 091268)	Hospital Admissions	Pollutant: CO	Increment: 0.5 ppm
Period of Study: 1/1995-12/2002		Averaging Time: 24-h avg	% Increase (Lower CI, Upper CI); lag
Location: Taipei, Taiwan		Mean (SE) unit: 0.9 ppm	Asthma (avg correlation between monitor pairs = 0.75 (13 monitors))
	Study Design: Time series	Range (Min, Max): (0.3, 3.6)	3.29% (-0.74 to 7.49); 0 .49% (-4.25 to 3.41); 1 -0.84% (-4.43 to 2.88); 2 0.48% (-4.02 to 3.18); 3 0.74% (-4.62 to 6.4); 0-3
	Statistical Analyses: Poisson	Copollutant: NR	Pneumonia (avg correlation between monitor pairs = 0.75 (13 monitors)) 1.91% (-1.97 to 5.95); 0 0.03% (-3.65 to 3.85); 1 0.36% (-3.2 to 4.04); 2 -1.29% (-4.77 to 2.32); 3 0.21% (-5.03 to 5.73); 0-3
	Age Groups Analyzed: All ages		Asthma (avg correlation between monitor pairs = 0.88 (5 monitors)) 1.68% (-1.68 to 5.15); 0 -1.19% (-4.29 to 2.01); 1 -0.83% (-3.83 to 2.26); 2 -0.35% (-3.32 to 2.71); 3 -0.31% (-4.9 to 4.5); 0-3 Pneumonia (avg correlation between monitor pairs = 0.88 (5 monitors)) 1.24% (-2.02 to 4.6); 0 -0.01% (-3.06 to 3.13); 1 0.57% (-2.4 to 3.62); 2 -0.85% (-3.78 to 2.16); 3 0.31% (-4.23 to 5.06); 0-3
			Asthma (monitors with ≥ 0.75 between monitor correlations (11 monitors), avg correlation between monitor pairs = 0.81) 2.87% (-0.91 to 6.79); 0 -0.71% (-4.2 to 2.91); 1 -0.73% (-4.08 to 2.73); 2 -0.41% (-3.72 to 3.01); 3 0.51% (-4.6 to 5.89); 0-3 Pneumonia (monitors with ≥ 0.75 between monitor correlations (11 monitors) to avg correlation between monitor pairs = 0.81) 0.98% (-1.68 to 5.76); 0 -0.12% (-3.54 to 3.42); 1 0.37% (-2.95 to 3.8); 2 -1.08% (-4.34 to 2.3); 3 0.3% (-4.71 to 5.57); 0-3

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Bellini et al. (2007, 097787) Period of Study: 1996-2002 Location: 15 Italian cities	Hospital Admissions Health Outcome: Respiratory conditions Study Design: Time-series; Meta-analysis Statistical Analyses: 1. GLM for city-specific estimates 2. Bayesian random-effects for meta analysis Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: NR Mean (SD) unit: NR Range (Min, Max): NR Copollutant: correlation NR	Increment: 1 mg/m ³ % Increase (Lower CI, Upper CI); Lag: Respiratory conditions All ages: Season: Winter: 0.58%; 0-1 Summer: 3.47%; 0-1 All Season: 1.25%; 0-3 Note: Estimates from Biggeri et al. (2004)
Author: Braga et al. (2001, 016275) Period of Study: 1/1993-11/1997 Location: Sao Paulo, Brazil	Hospital Admissions Health Outcome (ICD9): Respiratory (460-519) Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: ≤ 2 yr 3-5 yr 6-13 yr 14-19 yr 0-19 yr	Pollutant: CO Averaging Time: Maximum 8-h avg Mean (SD) unit: 4.8 (2.3) ppm Range (Min, Max): (0.6, 19.1) Copollutant: correlation PM ₁₀ : r = 0.60 O ₃ : r = -0.07 SO ₂ : r = 0.47	Increment: 3 ppm % Increase (Lower CI, Upper CI); lag: Respiratory Age Group: ≤ 2: 5.00% (3.30-6.80); 0-6 3-5: 4.90% (1.40-8.50); 0-6 6-13: 1.00% (-2.50 to 4.60); 0-6 14-19: 11.30% (5.90-16.80); 0-6 0-19: 4.90% (3.50-6.40); 0-6
Author: Burnett et al. (1999, 017269) Period of Study: 1/1980-12/1994 Location: Toronto, ON, Canada	Hospital Admissions Health Outcome (ICD9): Asthma (493); COPD (490-492, 496); respiratory infection (464, 466, 480-487, 494) Study Design: Time-series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.18 ppm IQR (25th, 75th): (0.9, 1.4) Copollutant: correlation PM _{2.5} : r = 0.49 PM _{10-2.5} : r = 0.20 PM ₁₀ : r = 0.43 NO ₂ : r = 0.55 SO ₂ : r = 0.37 O ₃ : r = -0.23	Increment: 1.18 ppm % Increase (t-value); lag: Asthma: 5.35% (3.92); 0 COPD: 2.93% (1.48); 0 Respiratory Infection: 5.00% (4.25); 0 Asthma: Multipollutant model CO, SO ₂ , O ₃ : 5.15% CO, PM _{2.5} , SO ₂ , O ₃ : 4.63% CO, PM _{10-2.5} , SO ₂ , O ₃ : 5.25% CO, PM ₁₀ , SO ₂ , O ₃ : 4.80% CO, PM _{10-2.5} , O ₃ : 4.00% COPD: Multipollutant model CO, SO ₂ , O ₃ : 3.02% CO, PM _{2.5} , SO ₂ , O ₃ : 2.46% CO, PM _{10-2.5} , SO ₂ , O ₃ : 3.00% CO, PM ₁₀ , SO ₂ , O ₃ : 2.75% CO, PM _{10-2.5} , O ₃ : 3.00%
Author: Burnett et al. (2001, 093439) Period of Study: 1/1980-12/1994 Location: Toronto, ON, Canada	Hospital Admissions Health Outcome (ICD9): Asthma (493); Acute bronchitis/bronchiolitis (466); croup (464.4); pneumonia (480-486) Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: <2 yr	Pollutant: CO Averaging Time: 1-h avg Mean (SD) unit: 1.9 ppm IQR (25th, 75th): (1.3, 2.3) Copollutant: correlation O ₃ : r = 0.24	Increment: 1.9 ppm % Increase (Lower CI, Upper CI); lag: Respiratory problems CO: 19.20%; 0-1 CO, O ₃ : 14.30%; 0-1

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Cakmak et al. (2006, 093272) Period of Study: 4/1993-3/2000 Location: 10 Canadian cities	Hospital Admissions Health Outcome (ICD9): Actue bronchitis/bronchiolitis (466); pneumonia (480-486); chronic/ unspecified bronchitis (490, 491); emphysema (492); asthma (493); bronchiectasis (494); chronic airway obstruction (496) Study Design: Time series	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.8 ppm Range (Min, Max): (0.0, 6.5) Copollutant: correlation SO ₂ , NO ₂ , O ₃	Increment: 0.8 ppm % Increase (Lower CI, Upper CI); lag: Respiratory disease CO: 0.60% (0.20, 1); 2.8 CO, SO ₂ , NO ₂ , O ₃ : -0.20% (-0.70- 0.30); 2.8
Author: Cheng et al. (2007, 093034) Period of Study: 1996-2004 Location: Kaohsiung, Taiwan	Hospital Admissions Health Outcome (ICD9): Pneumonia (480-486) Study Design: Bidirectional case-crossover	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.76 ppm Range (Min, Max): (0.14, 1.72) Copollutant: correlation PM ₁₀ , SO ₂ , NO ₂ , O ₃	Increment: 0.31 ppm Odds Ratio (Lower CI, Upper CI); lag: OR for pneumonia and exposure to various pollutants for all ages in areas $\geq 25^{\circ}\text{C}$ or $<25^{\circ}\text{C}$ Pollutant and Temperature CO, $\geq 25^{\circ}\text{C}$: 1.18 (1.14-1.23); 0-2 CO, $<25^{\circ}\text{C}$: 1.47 (1.41-1.53); 0-2 CO, PM ₁₀ , $\geq 25^{\circ}\text{C}$: 1.15 (1.11-1.2); 0-2 CO, PM ₁₀ , $<25^{\circ}\text{C}$: 1.28 (1.21-1.35); 0-2 CO, SO ₂ , $\geq 25^{\circ}\text{C}$: 1.22 (1.17-1.27); 0-2 CO, SO ₂ , $<25^{\circ}\text{C}$: 1.49 (1.42-1.56); 0-2 CO, NO ₂ , $\geq 25^{\circ}\text{C}$: 1.2 (1.15-1.27); 0-2 CO, NO ₂ , $<25^{\circ}\text{C}$: 1.01 (0.95-1.08); 0-2 CO, O ₃ , $\geq 25^{\circ}\text{C}$: 1.16 (1.12-1.2); 0-2 CO, O ₃ , $<25^{\circ}\text{C}$: 1.44 (1.38-1.5); 0-2
Author: Chiu et al. (2009, 190249) Period of Study: 1996-2004 Location: Taipei, Taiwan	Hospital Admissions Health Outcome: pneumonia HA Study Design: case-crossover	Averaging Time: 24h Mean (SD) unit: 1.26 ppm Range (min, max): 0.12, 3.66 Copollutant: correlation PM ₁₀ : r = 0.34 SO ₂ : r = 0.57 NO ₂ : r = 0.69 O ₃ : r = -0.31	Increment: 0.57 ppm (IQR) OR Estimate [Lower CI, Upper CI]; lag: Lags examined: one wk before to one wk after CO: $\geq 23^{\circ}\text{C}$: 1.25 (1.21, 1.29) $<23^{\circ}\text{C}$: 1.12 (1.09, 1.15) CO + PM ₁₀ : $\geq 23^{\circ}\text{C}$: 1.23 (1.19, 1.27) $<23^{\circ}\text{C}$: 1.05 (1.02, 1.09) CO + SO ₂ : $\geq 23^{\circ}\text{C}$: 1.25 (1.21, 1.30) $<23^{\circ}\text{C}$: 1.27 (1.22, 1.31) CO + NO ₂ : $\geq 23^{\circ}\text{C}$: 0.97 (0.93, 1.02) $<23^{\circ}\text{C}$: 1.14 (1.09, 1.20) CO + O ₃ : $\geq 23^{\circ}\text{C}$: 1.24 (1.20, 1.28) $<23^{\circ}\text{C}$: 1.21 (1.17, 1.24)

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Cho et al. (2000, 099051) Period of Study: 1/1996-12/1996 Location: 3 South Korea cities:	Hospital Admissions Health Outcome (ICD9): Bronchial asthma; COPD; bronchitis Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: All Ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Daejeon: 1.424 (0.611) ppm Ulsan: 0.950 (0.211) ppm Suwon: 1.270 (0.549) ppm Range (Min, Max): Daejeon: (.364, 3.504) Ulsan: (.380, 1.675) Suwon: (.250, 3.616) Copollutant: correlation Daejeon SO_2 : r = 0.280; NO_2 : r = 0.041; TSP : r = 0.193; O_3 : r = -0.101; O_3 Max: r = -0.069 Ulsan SO_2 : r = 0.108; NO_2 : r = 0.446; TSP : r = 0.286; O_3 : r = -0.195; O_3 Max: r = -0.107 Suwon SO_2 : r = 0.556; NO_2 : r = 0.291; TSP : r = 0.496; O_3 : r = -0.371; O_3 Max: r = -0.365	Increment: 1,000 ppm Relative Risk (Lower CI, Upper CI); lag: Estimates obtained using dummy variables to apply environmental indicators to the model Daejeon CO: 1.26 (1.08-1.47) $\text{TSP}, \text{SO}_2, \text{NO}_2, \text{O}_3$: 1.21 (1.02-1.44) Ulsan CO: 3.55 (1.65-7.63) $\text{TSP}, \text{SO}_2, \text{NO}_2, \text{O}_3$: 2.51 (1.06-5.93) Suwon CO: 1.24 (0.97-1.59) $\text{TSP}, \text{SO}_2, \text{NO}_2, \text{O}_3$: 1.19 (0.88-1.61) Estimates obtained using actual measured integrated environmental pollution indicator values Daejeon CO: 1.34 (1.14-1.58) Ulsan CO: 1.27 (0.94-1.71) Suwon CO: 3.55 (1.27-9.93)
Author: Delfino et al. (2008, 156390) Period of Study: January 1, 2000-December 31, 2003 Location: Orange County, California	ED Visits Health Outcome: Asthma Study Design: Longitudinal, Cohort Statistical Analyses: Proportional hazards models in SAS version 9.2 Age Groups Analyzed: 0-18 yr Sample Description: Various gender, race, insurance status, income, poverty level, residence distance to treating hospital	Averaging Time: NR Mean (SD) unit: Cool season: 0.114 (0.052), Warm season: 0.103 (0.048) Range (Min, Max): Cool season: 0.014 -0.378, Warm season: 0.013-0.482 Copollutant: NOx	Increment: 0.056 ppm HR (95% CI): Unadjusted: 1.072 (1.016 – 1.131), Adjusted: 1.073 (1.013 – 1.137), Male: 1.054 (0.978 – 1.137), Female: 1.100 (1.011 – 1.197), 0 yr: 1.158 (1.041 – 1.289), 1-5 yr: 1.021 (0.933 – 1.117), 6-18 yr: 1.076 (0.972 – 1.191), Median or less poverty: 1.054 (0.979 – 1.134), Greater than the median poverty: 1.094 (1.006 – 1.190), Greater than the median income: 1.120 (1.034 – 1.213), Median or less income: 1.041 (0.959 – 1.129), Private insurance: 1.102 (1.006 – 1.206), Government sponsored or self-pay insurance: 1.061 (0.989 – 1.138), Unknown insurance: 0.913 (0.591 – 1.412), White: 1.113 (1.027 – 1.205), Hispanic: 1.081 (0.996 – 1.173), Non-Hispanic nonwhite: 0.804 (0.601 – 1.074) Lags examined: NR <p>The point estimates for CO are stronger in girls than in boy and in infants than in older children. There is little difference in coefficients between adjusted and unadjusted CO models. There were significant increased risks of repeated hospital encounters of 7% to 10% per IQR increase in traffic-related CO exposure.</p>
Author: Farhat et al. (2005, 089461) Period of Study: 8/1996-8/1997 Location: Sao Paulo, Brazil	Hospital Visits & ED Visits Health Outcome (ICD9): Pneumonia/bronchopneumonia (480-486); asthma (493); bronchiolitis (466) Study Design: Time-series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: Max 8-h avg Mean (SD) unit: 3.8 (1.6) ppm Range (Min, Max): (1.1, 11.4) Copollutant: correlation PM_{10} : r = 0.72; SO_2 : r = 0.49; NO_2 : r = 0.59; O_3 : r = -0.8	Increment: 1.8 ppm % Increase (Lower CI, Upper CI); lag: Lower Respiratory Tract Disease ED Visits $\text{CO}, \text{PM}_{10}$: -0.10% (-5.60 to 5.30); 0-2 CO, NO_2 : -1.20% (-6.70 to 4.20); 0-2 CO, SO_2 : 3.70% (-1.00 to 8.40); 0-2 CO, O_3 : 4.80% (0.50-9.10); 0-2 $\text{CO}, \text{PM}_{10}, \text{NO}_2, \text{SO}_2, \text{O}_3$: -0.64% (-6.90 to 5.60); 0-2 Pneumonia/ Bronchopneumonia Hospital Admissions $\text{CO}, \text{PM}_{10}$: 4.40% (-7.90 to 16.70); 0-2 CO, NO_2 : 4.40% (-88.70 to 17.50); 0-2 CO, SO_2 : 7.80% (-2.50 to 18.20); 0-2 CO, O_3 : 9.60% (-0.50 to 19.70); 0-2 $\text{CO}, \text{PM}_{10}$ to $\text{NO}_2, \text{SO}_2, \text{O}_3$: 5.10% (-9.60 to 19.70); 0-2 Asthma/ Bronchiolitis Hospital Admissions $\text{CO}, \text{PM}_{10}$: 6.10% (-14.90 to 27.10); 0-2 CO, NO_2 : 2.40% (-16.90 to 21.70); 0-2 CO, SO_2 : 10.60% (-6.60 to 27.80); 0-2 CO, O_3 : 12.40% (-3.60 to 28.40); 0-2 $\text{CO}, \text{PM}_{10}$ to $\text{NO}_2, \text{SO}_2, \text{O}_3$: 8.80% (-15.60 to 33.30); 0-2

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Fung et al. (2006, 089789) Period of Study: 6/1995-3/1999 Location: Vancouver, Canada	Hospital Admissions Health Outcome (ICD9): Respiratory Illness Study Design: 1. Dewanji and Moolgavkar 2. Time-series 3. Bidirectional case-crossover Statistical Analyses: 1. Dewanji and Moolgavkar 2. Poisson 3. Conditional logistic regression Age Groups Analyzed: ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.69 (0.25) ppm Range (Min, Max): (0.28, 2.03) Copollutant: correlation CoH: $r = 0.85$; O_3 : $r = -0.53$; NO_2 : $r = 0.74$; SO_2 : $r = 0.61$; PM_{10} : $r = 0.46$; $PM_{2.5}$: $r = 0.23$; $PM_{10-2.5}$: $r = 0.51$ Time-series	Increment: 0.24 ppm Relative Risk (Lower CI, Upper CI); lag Dewanji and Moolgavkar 1.008 (0.997-1.02); 0 1.012 (0.999-1.025); 0-2 1.010 (0.995-1.025); 0-4 1.009 (0.991-1.026); 0-6 Time-series 1.012 (1.000-1.023); 0 1.017 (1.003-1.032); 0-2 1.017 (1.001-1.035); 0-4 1.016 (0.996-1.036); 0-6 Bidirectional case-crossover 1.010 (0.006-1.023); 0 1.012 (0.996-1.027); 0-2 1.012 (0.995-1.03); 0-4 1.010 (0.991 1.031); 0-6
Author: Fusco et al. (2001, 020631) Period of Study: 1/1995 10/1997 Location: Rome, Italy	Hospital Admissions Health Outcome (ICD9): Respiratory conditions (460-519, excluding 470-478); acute respiratory infections plus pneumonia (460-466, 480-486); COPD (490-492, 494-496); asthma (493) Study Design: Time-series Statistical Analyses: Poisson GAM Age Groups Analyzed: All ages 0-14 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 3.6 (1.2) mg/m ³ IQR (25th, 75th): (2.8, 4.3) Copollutant: correlation All Year SO_2 : $r = 0.56$ NO_2 : $r = 0.31$ O_3 : $r = -0.57$ Cold Season SO_2 : $r = 0.37$ NO_2 : $r = 0.41$ O_3 : $r = -0.44$ Warm Season SO_2 : $r = 0.44$ NO_2 : $r = 0.59$ O_3 : $r = -0.38$	Increment: 1.5 mg/m ³ % Increase (Lower CI, Upper CI); lag: Age Group: All Ages Respiratory conditions 2.80% (1.30-4.30); 0 1.80% (0.20-3.30); 1 0.20% (-1.30 to 1.80); 2 0.50% (-2.00 to 1.10); 3 0.70% (-0.80 to 2.20); 4 CO, NO_2 : 2.30% (0.60-4.00); 0 Acute Respiratory Infections plus pneumonia 2.20% (0.00-4.40); 0 2.10% (-0.10 to 4.40); 0 1.70% (-0.50 to 4.00); 2 -0.90% (-3.00 to 1.30); 3 1.50% (-0.70 to 3.70); 4 CO, NO_2 : 0.00% (-2.30 to 2.40); 0 Asthma 5.50% (0.90-10.40); 0 0.80% (-3.80 to 5.70); 1 -1.30% (-5.90 to 3.50); 2 -3.00% (-7.40 to 1.60); 3 0.60% (-4.00 to 5.30); 4 CO, NO_2 : 4.80% (0.30-9.50); 0 COPD 4.30% (1.60-7.10); 0 -0.20% (-2.90 to 2.50); 1 -0.20% (-2.90 to 2.60); 2 -0.30% (-3.00 to 2.40); 3 -0.10% (-2.80 to 2.60); 4 CO, NO_2 : 4.80% (0.90-7.90); 0 Warm Season Respiratory Conditions: 10.80% (6.70-14.80); 0 Acute respiratory infections plus pneumonia: 8.60% (2.90-14.60); 0 COPD: 13.90% (6.80-21.50); 0 Age Group: 0-14 Respiratory conditions 2.50 (-0.30 to 5.50); 0 0.80 (-2.10 to 3.80); 1; 0.20 (-2.70 to 3.10); 2 -1.00 (-3.70 to 1.90); 3 3.20 (0.40-6.20); 4 CO, NO_2 : 4.10 (-1.20 to 9.80); 1 Acute Respiratory Infections plus Pneumonia 2.50 (-0.80 to 5.80); 0 -0.10 (-3.40 to 3.20); 1 0.90 (-2.30 to 4.30); 2 -2.00 (-5.10 to 1.20); 3 3.20 (0.00-6.60); 4 CO, NO_2 : 6.90 (0.80-13.40); 1 Asthma 6.30 (-0.50 to 13.50); 0 8.20 (1.10-15.70); 1; -0.70 (-7.30 to 6.30); 2

Study	Design	Concentrations	Effect Estimates (95% CI)
			3.50 (-3.20 to 10.60); 3; 4.80 (-1.90 to 12.00); 4 CO, NO ₂ : 3.30 (-4.20 to 11.30); 1
Author: Gouveia and Fletcher (2000, 010436) Period of Study: 11/1992-9/1994 Location: Sao Paulo, Brazil	Hospital Admissions Health Outcome (ICD9): All respiratory diseases Pneumonia (480-486); asthma (493); bronchitis (466, 490, 491) Study Design: Time-series Statistical Analyses: Poisson Age Groups Analyzed: <1 yr; <5 yr	Pollutant: CO Averaging Time: Max 8-h avg Mean (SD) unit: 5.8 (2.4) ppm Range (Min, Max): (1.3, 22.8) Copollutant: correlation PM ₁₀ : r = 0.63 SO ₂ : r = 0.65 NO ₂ : r = 0.35	Increment: 6.9 ppm Relative Risk (Lower CI, Upper CI); lag: All respiratory diseases Age Group: <5: 1.017 (0.971-1.065); 0 Pneumonia Age Group: <5: 1.015 (0.961-1.071); 0; <1: 1.035 (0.975-1.099); 2 Asthma Age Group: <5: 1.081 (0.98-1.192); 0
Author: Hajat et al. (1999, 000924) Period of Study: 1/1992-12/1994 Location: London, U.K.	General Practitioner Visits Health Outcome (ICD9): Asthma (493); lower respiratory diseases (464, 466, 476, 480-483, 485-487, 490-492, 494-496, 500, 501, 503-505, 510-515, 518, 519, 786) Study Design: Time-series Statistical Analyses: Poisson Age Groups Analyzed: All ages 0-14 yr 15-64 yr ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: All yr: 0.8 (0.4) ppm Warm Season (April-September): 0.7 (0.3) ppm Cool Season (October-March): 1.0 (0.5) ppm Range (10th, 90th): All Year: (0.5, 1.3) Warm Season: (0.4, 1.0) Cool Season: (0.5, 1.6) Copollutant: correlation All Year NO ₂ : r = 0.72; SO ₂ : r = 0.51; BS: r = 0.85; O ₃ : r = -0.40; PM ₁₀ : r = 0.56 Warm Season NO ₂ : r = 0.70; SO ₂ : r = 0.32; BS: r = 0.65; O ₃ : r = -0.12; PM ₁₀ : r = 0.58 Cool Season NO ₂ : r = 0.84; SO ₂ : r = 0.58; BS: r = 0.87	Increment: 0.8 & 0.7 ppm % Increase (Lower CI, Upper CI); Lag: All Year: Asthma – Single Day Lags Increment: 0.8 ppm Age Group 0-14: 4.10% (-0.10 to 8.40); 2 15-64: 0.90% (-2.10 to 4.10); 0 ≥ 65: 7.50% (0.50-14.90); 2 All ages: 1.60% (-1.20 to 4.60); 2 Asthma – Cumulative exposure Increment: 0.7 ppm Age Group 0-14: 6.90% (1.30-12.90); 0-3 15-64: 1.00% (-3.20 to 5.40); 0-2 ≥ 65: 8.20% (0.40-16.60); 0-2 All ages: 1.80% (-1.50 to 5.20); 0-2 Lower Respiratory Diseases – Single Day Lags Increment: 0.8 ppm Age Group 0-14: 4.40 (1.70-7.10); 2 15-64: 1.10 (-0.70 to 3.00); 2 ≥ 65: -2.60 (-4.80 to -0.30); 3 All ages: 2.00 (0.50-3.40); 2 Lower Respiratory Diseases – Cumulative exposure Increment: 0.7 ppm for 0-2 and 0-3; 0.8 for 0-1 Age Group 0-14: 3.00% (-1.00 to 7.20); 0-3 15-64: -0.70% (-2.90 to 1.50); 0-1 ≥ 65: -1.60% (-5.10 to 2.00); 0-3 All ages: 1.80% (0.10-3.60); 0-2 Warm or Cold Seasons: Asthma, Increment: 0.8 ppm Age Group & Season 0-14 & Warm Season: 11.40% (3.30-20.00); 2 0-14 & Cold Season: 2.90% (-3.20 to 9.40); 2 15-64 & Warm Season: 4.80% (-0.60 to 10.60); 0 15-64 & Cold Season: -0.30% (-4.80 to 4.50); 0 ≥ 65 & Warm Season: 15.60% (3.10-29.60); 2 ≥ 65 & Cold Season: 4.20% (-6.00 to 15.60); 2 Lower Respiratory Diseases, Increment: 0.8 ppm Age Group & Season 0-14 & Warm Season: 2.70% (-2.90 to 8.60); 2 0-14 & Cold Season: 6.20% (2.30-10.20); 2 15-64 & Warm Season: 6.20% (2.30-10.20); 2 15-64 & Cold Season: 2.40% (-1.20 to 6.10); 2 ≥ 65 & Warm Season: 1.00% (-1.60 to 3.80); 2 ≥ 65 & Cold Season: -2.20% (-6.50 to 2.40); 3

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Hajat et al. (2002, 030358) Period of Study: 1/1992-12/1994 Location: London, U.K.	General Practitioner Visits Health Outcome (ICD9): Upper respiratory diseases (URD) Study Design: Time-series Statistical Analyses: Poisson, GAM, LOESS Age Groups Analyzed: 0-14 yr 15-64 yr ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: All yr: 0.8 (0.4) ppm Range (10th, 90th): All Year: (0.5, 1.3) Warm Season: (0.4, 1.0) Cool Season: (0.5, 1.6) Copollutant: NR	Increment: 0.6 ppm, 0.8 ppm, & 1.1 ppm % Increase (Lower CI, Upper CI); lag: Warm Season, Increment: 0.6 ppm Age Group 0-14: 2.90% (-0.60 to 6.40); 1 14-64: 7.90% (4.80-11.10); 1 ≥ 65: 4.90% (-1.80 to 12.10); 3 Cold Season, Increment: 1.1 ppm Age Group 0-14: -2.50% (-4.90 to 0.10); 1 14-64: 0.60% (-1.60 to 2.90); 1 ≥ 65: 5.60% (0.90-10.60); 3 All Year, Increment: 0.8 ppm Age Group 0-14: -2.20% (-4.00 to -0.30); 1 14-64: 2.70% (0.10-5.50); 1 ≥ 65: 5.80% (2.40 to 9.30); 3
Author: Hapcioglu et al. (2006, 093263) Period of Study: 1/1997-12/2001 Location: Istanbul, Turkey	Hospital Admissions Health Outcome (ICD9): COPD (490-492, 494-496) Study Design: Cross sectional Statistical Analyses: Pearson Correlation Coefficient Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: Monthly Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Correlation Coefficient: Between CO exposure and COPD: 0.57 Between CO exposure and COPD when controlling for temperature: 0.25
Author: Hinwood et al. (2006, 088976) Period of Study: 1/1992-12/1998 Location: Perth, Australia	Hospital Admissions Health Outcome (ICD9): COPD (490.00-496.99 excluding asthma); pneumonia/influenza (480.00-489.99); Asthma (493) Study Design: Case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: Max 8-h avg Mean (SD) unit: All Year: 2.3 (1.3) ppm; November-April: 2.2 (1.3) ppm; May-October: 2.4 (1.2) ppm Range (10th, 90th): All Year: (0.9, 4.2) November-April: (0.8, 4.2) May-October: (1.1, 4.2) Copollutant: correlation All Year: NO ₂ : r = 0.57 O ₃ : r = 0.00 November-April: NO ₂ : r = 0.55 O ₃ : r = 0.00 May-October: NO ₂ : r = 0.57 O ₃ : r = 0.16	Increment: 2.3 ppm Odds Ratio (Lower CI, Upper CI); Lag: Pneumonia 0.99999 (0.9737-1.0268); 0 1.00650 (0.9806-1.0331); 1 1.00351 (0.9779-1.0298); 2 1.00424 (0.9790-1.0301); 3 1.00581 (0.9752-1.0374); 0-1 1.01005 (0.9755-1.0458); 0-2 1.00805 (0.9701-1.0474); 0-3 COPD 0.99915 (0.9693-1.0297); 0 1.00205 (0.9727-1.0323); 1 0.98630 (0.9577-1.0158); 2 0.98970 (0.9619-1.0182); 3 0.99960 (0.9647-1.0357); 0-1 0.99260 (0.9538-1.0329); 0-2 0.99160 (0.9493-1.0357); 0-3
Author: Hwang and Chan (2002, 023222) Period of Study: 1998 Location: 50 communities in Taiwan	Clinic Visits Health Outcome (ICD9): Lower respiratory tract infections (466, 480-486) Study Design: Time series Statistical Analyses: 1. General linear regression 2. Bayesian hierarchical modeling Age Groups Analyzed: All Ages 0-14 yr 15-64 yr ≥ 65 yr	Pollutant: CO Averaging Time: Max 8-h avg Mean (SD) unit: 1.00 (0.30) ppm Range (Min, Max): (0.51, 1.71) Copollutant: NR	Increment: 0.1 ppm % Increase (Lower CI, Upper CI); Lag: Age Group: All Ages 0.80% (0.60-1.00); 0 0.10% (-0.10 to 0.30); 1 0.10% (-0.10 to 0.30); 2 Age Group: 0-14 0.70% (0.50-1.00); 0 0.10% (-0.20 to 0.30); 1 0.20% (-0.10 to 0.40); 2 Age Group: 15-64 0.90% (0.60-1.10); 0 0.20% (0.00-0.50); 1 0.20% (-0.10 to 0.40); 2 Age Group: ≥ 65 1.10% (0.80-1.50); 0 0.60% (0.30-1.00); 1 0.40% (0.10-0.80); 2

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Ito et al. (2007, 091262)	ED Visits	Pollutant: CO	Increment: 1.3 ppm
Period of Study: 1999-2002	Health Outcome (ICD9): Asthma (493)	Averaging Time: Max 8-h avg	Relative Risk (Lower CI, Upper CI); Lag
Location: New York City, NY	Study Design: Time series	Mean (SD) unit: All Season: 1.31 (0.43) ppm Warm Months (April-September): 1.22 (0.32) ppm Cold Months (October-March): 1.41 (0.5) ppm	Warm months: 1.15 (1.07-1.25); 0-1
	Statistical Analyses: Poisson GLM		
	Age Groups Analyzed: All ages	Range (5th, 95th): All season: (0.77, 2.11) Warm months (April-September): (0.75, 1.82) Cold months (October-March): (0.78, 2.33)	
		Copollutant: NR	
Author: Jayaraman et al. (2008, 180352)	Hospital Admissions	Averaging Time: 24-h	Increment: 10 $\mu\text{g}/\text{m}^3$
Period of Study: 2004-2005	Health Outcome: respiratory	Mean (SD) unit: 2,379.14 (1,289.18) $\mu\text{g}/\text{m}^3$	RR Estimate [Lower CI, Upper CI] ; lag:
	Study Design: time series	Range (min, max): 588, 8458	Lags examined: lag days 0-3
Location: New Delhi, India	Statistical Analyses: Poisson regression (GAM)	Copollutant: SO_2 : r = 0.217* NO_2 : r = 0.204* SPM: r = 0.071 RSPM: r = 0.120 O_3 : r = 0.063	Single Pollutant: 0.9989 (0.985, 2.715), 2 Multi-pollutant: 0.998 (0.993, 1.004), 2
	Age Groups Analyzed: All ages		Winter, all ages: 1.027 (1.004, 1.051), 2
	Sample Description: daily HA for respiratory unit of Safdarjung hospital		Winter, males 50-69: 2.625 (1.048, 1.158)
		*p < 0.05	
Author: Karr et al. (2007, 090719)	Hospital Admissions	Pollutant: CO	Increment: 910 ppb, 960 ppb
Period of Study: 1995-2000	Health Outcome (ICD9): Acute bronchiolitis (466.1)	Averaging Time: 24-h avg	Odds Ratio (Lower CI, Upper CI); lag:
Location: South Coast Air Basin, CA	Study Design: Matched case control	Mean (SD) unit: Chronic: 1,770 ppb Subchronic: 1,720 ppb	Increment: 910 ppb Subchronic broncholitis: 1 (0.97-1.03)
	Statistical Analyses: Conditional logistic regression	Range (Min, Max): Chronic: (120, 8300) Subchronic: (130, 5070)	Increment: 960 ppb Chronic broncholitis: 1 (0.97-1.03)
	Age Groups Analyzed: Infants: 3 wk to 1 yr	Copollutant: NR	
Author: Karr et al. (2006, 088751)	Hospital Admissions	Pollutant: CO	Increment: 1361, 1400 ppb
Period of Study: 1995-2000	Health Outcome (ICD9): Acute bronchiolitis (466.1)	Averaging Time: 24-h avg	Odds Ratio (Lower CI, Upper CI); Lag
Location: South Coast Air Basin, CA	Study Design: Case crossover	Mean (SD) unit: 1-day lag: Index*: 1,730 ppb Referent*: 1,750 ppb	Increment: 1361 ppb Age Group: Overall: 0.99 (0.96-1.02); 1 25-29 wk: 0.86 (0.68-1.1); 1 29 1/7 – 34 wk: 1 (0.86-1.15); 1
		4-day lag: Index*: 1,760 ppb Referent*: 1,790 ppb	34 1/7 – 37 wk: 0.95 (0.87-1.04); 1 37 1/7 – 44 wk: 1 (0.97-1.03); 1
	Statistical Analyses: Conditional logistic regression	Range (Min, Max): Lag 1: Index*: (4, 9600) Referent*: (4, 9600)	Increment: 1400 ppb Age Group: Overall: 0.97 (0.94-1); 4 25-29 wk: 0.93 (0.72-1.2); 4
	Age Groups Analyzed: Infants: 3 wk to 1 yr	Lag 4: Index* (4, 8710) Referent* (4, 9600)	29 1/7 – 34 wk: 0.89 (0.77-1.03); 4 34 1/7 – 37 wk: 0.98 (0.90-1.08); 4 37 1/7 – 44 wk: 0.97 (0.94-1); 4
		Copollutant: NR	
		* Index days: days lagged in reference to date of hospitalization of a case.	
		Referent days: are for each case and includes all days that are the same day of wk and in the same mo as the index day for that case for CO.	

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Kim et al. (2007, 092837) Period of Study: 2002 Location: Seoul, Korea	Hospital Admissions Health Outcome (ICD10): Asthma (J45 and J46) Study Design: Bidirectional case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All Ages	Pollutant: CO Averaging Time: Max 8-h avg Mean (SD) unit: Daily Concentration: 8.6 (4.6) ppm Relevant Concentration: 2.8 (2.8) ppm Range (Min, Max): Daily Concentration: (0.8, 44.0) Relevant Concentration: (0.0, 30.4) Copollutant: NR	Relative Risk (Lower CI, Upper CI); lag: Individual Level SEP Quintile 1: 1.06 (1.02-1.09); 1-3 ma Quintile 2: 1.05 (1.02-1.09); 1-3 ma Quintile 3: 1.05 (1.01-1.08); 1-3 ma Quintile 4: 1.07 (1.03-1.11); 1-3 ma Quintile 5: 1.05 (1.00-1.09); 1-3 ma Regional Level SEP Quintile 1: 0.99 (0.92-1.07); 1-3 ma Quintile 2: 1.06 (1.02-1.11); 1-3 ma Quintile 3: 1.04 (1.02-1.07); 1-3 ma Quintile 4: 1.10 (1.06-1.15); 1-3 ma Quintile 5: 1.06 (1.03-1.09); 1-3 ma Overall: 1.06 (1.04-1.07); 1-3 ma Relative Effect Modification for SES Individual Level SEP Quintile 1: 1 Quintile 2: 1 (0.95-1.04); 1-3 ma Quintile 3: 0.99 (0.94-1.03); 1-3 ma Quintile 4: 1.02 (0.97-1.06); 1-3 ma Quintile 5: 0.99 (0.94-1.04); 1-3 ma Regional Level SEP Quintile 1: 1 Quintile 2: 1.05 (0.97-1.14); 1-3 ma Quintile 3: 1.03 (0.96-1.11); 1-3 ma Quintile 4: 1.08 (1-1.16); 1-3 ma Quintile 5: 1.05 (0.97-1.13); 1-3 ma
Author: Kontos et al. (1999, 011326) Period of Study: 1/1987-12/1992 Location: Piraeus, Greece	Hospital Admissions Health Outcome (ICD9): Respiratory conditions (laryngitis, bronchiolitis, tonsillitis, acute rhinopharyngitis, otitis, bronchopneumonia, pneumonia, asthma) Study Design: Time series Statistical Analyses: Stochastic dynamical system approach Age Groups Analyzed: 0-14 yr	Pollutant: CO Averaging Time: 24-h avg Mean Range (SD) unit: 1987: 4.2 mg/m ³ 1992: 3.6 mg/m ³ Range (Min, Max): NR Copollutant: correlation 1987-1989 Smoke: r = 0.2979; SO ₂ : r = 0.2166; NO ₂ : r = 0.1913 1990-1992 Smoke: r = 0.5383; SO ₂ : r = 0.43283; NO ₂ : 0.5223	This study did not present quantitative results for CO.
Author: Lee et al. (2002, 034826) Period of Study: 12/1997-12/1999 Location: Seoul, Korea	Hospital Admissions Health Outcome (ICD10): Asthma (J45, J46) Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: <5 yr	Pollutant: CO Averaging Time: 1-h max Mean Range (SD) unit: 1.8 (0.7) ppm Copollutant: correlation PM ₁₀ : r = 0.598 SO ₂ : r = 0.812 NO ₂ : r = 0.785 O ₃ : r = -0.388	Increment: 1.0 ppm Relative Risk (Lower CI, Upper CI); lag: RR for asthma and exposure to various pollutants for children under 15 yr old Pollutant: CO: 1.16 (1.10-1.22); 2-3 avg CO, PM ₁₀ : 1.13 (1.07-1.20); 2-3 avg CO, SO ₂ : 1.17 (1.08-1.27); 2-3 avg CO, NO ₂ : 1.04 (0.95-1.14); 2-3 avg CO, O ₃ : 1.16 (1.11-1.22); 2-3 avg CO, O ₃ , PM ₁₀ : 1.148 (1.084-1.217); 2-3 avg CO, O ₃ , PM ₁₀ , SO ₂ : 1.168 (1.075-1.269); 2-3 avg CO, O ₃ , PM ₁₀ , SO ₂ , NO ₂ : 1.098 (0.994-1.214); 2-3 avg

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Lee et al. (2006, 098248) Period of Study: 1/2002-12/2002 Location: Seoul, Korea	Hospital Admissions Health Outcome (ICD10): Asthma (J45-46) Study Design: Time series Statistical Analyses: GAM with stringent parameters Age Groups Analyzed: <15 yr	Pollutant: CO Averaging Time: Maximum 2-h avg Mean (SD) unit: High SES: 6.08 (2.10) ppb Moderate SES: 6.35 (2.44) ppb Low SES: 6.67 (2.59) ppb Range (Min, Max): NR Copollutant: correlation NO ₂ : r = 0.55 SO ₂ : r = 0.72 PM ₁₀ : r = 0.28 O ₃ : r = -0.36	Increment: 3.01 ppb, 0.26 ppb, 4.52 ppb, 3.68 ppb Relative Risk (Lower CI, Upper CI); lag: Increment: 3.01 ppb Overall: 1.07 (0.96-1.20); 0 Increment: 0.26 ppb High SES: 1.06 (0.96-1.17); 0 Increment: 4.52 ppb Moderate SES: 0.96 (0.84-1.10); 0 Increment: 3.68 ppb Low SES: 1.02 (0.85-1.24); 0
Author: Lee et al. (2007, 090707) Period of Study: 1996-2003 Location: Kaohsiung, Taiwan	Hospital Admissions Health Outcome (ICD9): COPD (490-492, 494, 496) Study Design: Bidirectional case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.77 ppm Range (Min, Max): (0.23, 1.72) Copollutant: PM ₁₀ SO ₂ NO ₂ O ₃	Increment: 0.29 ppm Odds Ratio (Lower CI, Upper CI); lag: CO <25°C: 1.398 (1.306-1.496); 0-2 ≥ 25°C: 1.189 (1.123-1.259); 0-2 CO, PM ₁₀ <25°C: 1.257 (1.152-1.371); 0-2 ≥ 25°C: 1.149 (1.079-1.224); 0-2 CO, SO ₂ <25°C: 1.396 (1.295-1.504); 0-2 ≥ 25°C: 1.241 (1.161-1.326); 0-2 CO, NO ₂ <25°C: 0.973 (0.877-1.080); 0-2 ≥ 25°C: 1.196 (1.104-1.297); 0-2 CO, O ₃ <25°C: 1.378 (1.286-1.477); 0-2 ≥ 25°C: 1.170 (1.105-1.239); 0-2
Author: Lin et al. (1999, 040437) Period of Study: 5/1991-4/1993 Location: Sao Paulo, Brazil	ED Visits Health Outcome (ICD9): Respiratory illness (lower respiratory illness, upper respiratory illness, wheezing) Study Design: Time series Statistical Analyses: Poisson Age Groups Analyzed: <3 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 5 ppm Range (Min, Max): (1, 12) Copollutant: correlation PM ₁₀ : r = 0.50 NO ₂ : r = 0.35 SO ₂ : r = 0.56 O ₃ : r = 0.04	Increment: NR Relative Risk (Lower CI, Upper CI); lag: Overall Respiratory Illnesses CO: 1.206 (1.066-1.364); 0-5 CO, PM ₁₀ , O ₃ , SO ₂ , NO ₂ : 0.945 (0.808-1.105); 0-5 Lower Respiratory Illness CO: 1.203 (0.867-1.669); 0-5 CO, PM ₁₀ , O ₃ , SO ₂ , NO ₂ : 0.971 (0.641-1.472); 0-5 Upper Respiratory Illness CO: 1.237 (1.072-1.428); 0-5 CO, PM ₁₀ , O ₃ , SO ₂ , NO ₂ : 0.944 (0.785-1.135); 0-5 Wheezing CO: 0.813 (0.606-1.091); 0-5 CO, PM ₁₀ , NO ₂ , SO ₂ , O ₃ : 0.74 (0.505-1.085); 0-5

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Lin et al. (2003, 042549) Period of Study: 1/1981-12/1993 Location: Toronto, ON, Canada	Hospital Admissions Health Outcome (ICD9): Asthma (493) Study Design: Case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: 6-12 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.18 (0.50) ppm Range (Min, Max): (0, 6.10) Copollutant: correlation SO ₂ : r = 0.37 NO ₂ : r = 0.55 O ₃ : r = -0.16 PM _{2.5} : r = 0.45 PM _{10-2.5} : r = 0.17 PM ₁₀ : r = 0.38	Increment: 0.5 ppm Odds Ratio (Lower CI, Upper CI); lag: Boys: Adjusting for Daily Weather Variables 1.05 (1.11); 1 / 1.07 (1.01-1.14); 2 1.08 (1.01-1.16); 3 / 1.08 (1.1-1.17); 4 1.07 (0.99-1.16); 5 / 1.07 (0.98-1.17); 6 1.07 (0.98-1.17); 7 Adjusting for PM and Daily Weather Variables 1.05 (0.99-1.11); 1 / 1.08 (1.01-1.16); 2 1.09 (1.01-1.18); 3 / 1.10 (1.02-1.20); 4 1.09 (1.00-1.18); 5 / 1.09 (0.99-1.19); 6 1.09 (0.99-1.20); 7 Girls: Adjusting for Daily Weather Variables 1.00 (0.93-1.06); 1 / 1.01 (0.94-1.10); 2 1.00 (0.91-1.09); 3 / 0.98 (0.89-1.09); 4 1.01 (0.91-1.13); 5 / 1.03 (0.92-1.16); 6 1.04 (0.93-1.17); 7 Adjusting for PM and Daily Weather Variables 1.00 (0.93-1.07); 1 / 1.01 (0.92-1.10); 2 0.99 (0.90-1.09); 3 / 0.97 (0.87-1.08); 4 0.99 (0.89-1.11); 5 / 1.02 (0.90-1.15); 6 1.05 (0.93-1.20); 7
Author: Lin et al. (2004, 055600) Period of Study: 1/1987-12/1998 Location: Vancouver, BC Canada	Hospital Admissions Health Outcome (ICD9): Asthma (493) Study Design: Time series Statistical Analyses: GAM, LOESS Age Groups Analyzed: 6-12 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.96 (0.52) ppm Range (Min, Max): (0.23, 4.90) Copollutant: correlation SO ₂ : r = 0.67 NO ₂ : r = 0.73 O ₃ : r = -0.35	Increment: 0.5 ppm Relative Risk (Lower CI, Upper CI); lag: Boys High SES: 1.06 (0.98-1.14); 1 / 1.06 (0.97-1.15); 2 1.07 (0.97-1.17); 3 / 1.03 (0.93-1.14); 4 1.01 (0.91-1.12); 5 / 1.01 (0.91-1.13); 6 1.06 (0.94-1.18); 7 Low SES: 1.06 (0.99-1.14); 1 / 1.03 (0.95-1.12); 2 1.01 (0.93-1.11); 3 / 0.99 (0.90-1.09); 4 0.96 (0.87-1.06); 5 / 0.98 (0.88-1.08); 6 0.98 (0.88-1.09); 7 Girls High SES: 1.05 (0.94-1.16); 1 / 1.02 (0.90-1.15); 2 0.97 (0.85-1.11); 3 / 0.95 (0.83-1.10); 4 0.93 (0.80-1.08); 5 / 0.95 (0.82-1.11); 6 1.01 (0.87-1.19); 7 Low SES: 1.01 (0.92-1.11); 1 / 0.98 (0.89-1.10); 2 0.99 (0.88-1.11); 3 / 1.05 (0.93-1.19); 4 1.07 (0.94-1.21); 5 / 1.07 (0.94-1.23); 6 1.04 (0.91-1.20); 7
Author: Lin et al. (2005, 087828) Period of Study: 1998-2001 Location: Toronto, Canada	Hospital Admissions Health Outcome (ICD9): Respiratory infections (464, 466, and 480-487) Study Design: Bidirectional case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: <5 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.16 (0.38) ppm Range (Min, Max): (0.38, 2.45) Copollutant: correlation PM _{2.5} : r = 0.10 PM _{10-2.5} : r = 0.06 PM ₁₀ : r = 0.10 SO ₂ : r = 0.12 NO ₂ : r = 0.20 O ₃ : r = -0.11	Increment: 0.44 ppm Odds Ratio (Lower CI, Upper CI); Lag Boys No adjustment: 1.11 (1.01-1.22); 0-3 / 1.10 (1.00-1.22); 0-5 Adjustment for weather variables: 1.13 (1.03-1.24); 0-3 / 1.13 (1.02-1.25); 0-5 Adjustment for weather variables and PM: 1.08 (0.98-1.20); 0-3 / 1.08 (0.97-1.20); 0-5 Girls No adjustment: 0.99 (0.89-1.10); 0-3 / 1.00 (0.89-1.13); 0-5 Adjustment for weather variables: 1.02 (0.92-1.14); 0-3 / 1.05 (0.93-1.18); 0-5 Adjustment for weather variables and PM: 1.01 (0.90-1.13); 0-3 / 1.02 (0.90-1.15); 0-5 Total No adjustment: 1.06 (0.98-1.14); 0-3 / 1.06 (0.98-1.15); 0-5 Adjustment for weather variables: 1.09 (1.01-1.17); 0-3 / 1.10 (1.01-1.19); 0-5 Adjustment for weather variables and PM: 1.05 (0.97-1.14); 0-3 / 1.06 (0.97-1.15); 0-5

Study	Design	Concentrations	Effect Estimates (95% CI)
<p>Author: Linn et al. (2000, 002839)</p> <p>Period of Study: 1992-1995</p> <p>Location: Los Angeles, CA</p>	<p>Hospital Admissions</p> <p>Health Outcome (ICD9): APR-DRG Codes: Pulmonary (75-101); COPD (88) ICD9 Codes: Asthma (493)</p> <p>Study Design: Time series</p> <p>Statistical Analyses: Poisson</p> <p>Age Groups Analyzed: 0-29 yr; ≥ 30 yr</p>	<p>Pollutant: CO</p> <p>Averaging Time: 24-h avg</p> <p>Mean (SD) unit: Winter 1.7 (0.8) ppm Spring 1.0 (0.3) ppm Summer 1.2 (0.4) ppm Fall 2.1 (0.8) ppm</p> <p>Range (Min, Max): Winter: (0.5, 5.3) Spring: (0.4, 2.2) Summer: (0.3, 2.7) Fall: (0.6, 4.3)</p> <p>Copollutant: correlation Winter NO₂: r = 0.89; PM₁₀: r = 0.78; O₃: r = -0.43 Spring NO₂: r = 0.92; PM₁₀: r = 0.54; O₃: r = 0.29 Summer NO₂: r = 0.94; PM₁₀: r = 0.72; O₃: r = 0.03 Fall NO₂: r = 0.84; PM₁₀: r = 0.58; O₃: r = -0.36</p>	<p>Increment: 1.0 ppm</p> <p>β (SE); lag: Pulmonary Age Group: ≥ 30 All Year: 0.007 Winter: 0.016 Spring: 0.014 Summer: 0.020 Fall: 0.020</p> <p>Asthma Age Group 0-29 All Year: 0.036</p> <p>COPD Age Group: ≥ 30 All Year: 0.028 Winter: 0.045 Fall: 0.039</p>

Study	Design	Concentrations	Effect Estimates (95% CI)
<p>Author: Luginaah et al. (2005, 057327)</p> <p>Period of Study: 4/1995-12/2000</p> <p>Location: Windsor, ON, Canada</p>	<p>Hospital Admissions</p> <p>Health Outcome (ICD9): Respiratory illness (460-519)</p> <p>Study Design: Time series and case crossover</p> <p>Statistical Analyses:</p> <ul style="list-style-type: none"> 1. Time-series: Poisson 2. Case-crossover: conditional logistic regression <p>Age Groups Analyzed:</p> <ul style="list-style-type: none"> All ages 0-14 yr 15-64 yr ≥ 65 yr 	<p>Pollutant: CO</p> <p>Averaging Time: 1-h max</p> <p>Mean (SD) unit: 1.3 (1.0) ppm</p> <p>Range (Min, Max): (0, 11.82)</p> <p>Copollutant: correlation</p> <ul style="list-style-type: none"> NO₂: r = 0.38 SO₂: r = 0.16 O₃: r = 0.10 COH: r = 0.31 PM₁₀: r = 0.21 	<p>Increment: 1.17 ppm</p> <p>Relative Risk (Lower CI, Upper CI); Lag</p> <p>Females and Case-crossover study design</p> <p>Age Group: All ages: 1.037 (0.968-1.111); 1 1.063 (0.976-1.158); 2 1.087 (0.982-1.203); 3</p> <p>Age Group: 0-14: 1.147 (1.006-1.307); 1 1.186 (1.020-1.379); 2 1.221 (1.022-1.459); 3</p> <p>Age Group: 15-64: 1.005 (0.884-1.141); 1 1.007 (0.859-1.181); 2 1.032 (0.858-1.240); 3</p> <p>Age Group: ≥ 65: 1.014 (0.922-1.116); 1 1.024 (0.907-1.156); 2 1.035 (0.893-1.200); 3</p> <p>Males and Case-crossover study design</p> <p>Age Group: All Ages: 0.950 (0.884-1.020); 1 0.945 (0.862-1.036); 2 0.965 (0.866-1.075); 3</p> <p>Age Group: 0-14: 1.003 (0.904-1.113); 1 0.997 (0.871-1.141); 2 0.970 (0.824-1.141); 3</p> <p>Age Group: 15-64: 1.036 (0.870-1.233); 1 1.033 (0.821-1.299); 2 0.991 (0.760-1.293); 3</p> <p>Age Group: ≥ 65: 0.867 (0.775-0.970); 1 0.865 (0.752-0.994); 2 0.946 (0.807-1.109); 3</p> <p>Female and Time-series study design</p> <p>Age Group: All Ages: 1.049 (0.993-1.108); 1 1.032 (0.993-1.188); 2 1.051 (0.993-1.112); 3</p> <p>Age Group: 0-14: 1.077 (0.979-1.184); 1 1.068 (1.001-1.139); 2 1.100 (0.997-1.213); 3</p> <p>Age Group: 15-64: 1.072 (0.962-1.195); 1 1.025 (0.944-1.112); 2 1.081 (0.963-1.213); 3</p> <p>Age Group: ≥ 65: 1.029 (0.957-1.118); 1 1.030 (0.928-1.144); 2 1.013 (0.899-1.142); 3</p> <p>Male and Time-series study design</p> <p>Age Group: All Ages: 0.989 (0.932-1.049); 1 0.986 (0.946-1.029); 2 0.987 (0.929-1.048); 3</p> <p>Age Group: 0-14: 1.034 (0.949-1.126); 1 0.996 (0.933-1.062); 2 0.968 (0.881-1.064); 3</p> <p>Age Group: 15-64: 0.994 (0.854-1.157); 1 0.988 (0.884-1.104); 2 0.951 (0.806-1.121); 3</p> <p>Age Group: ≥ 65: 0.901 (0.817-0.994); 1 0.904 (0.803-1.019); 2 0.963 (0.845-1.098); 3</p>

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Martins et al. (2002, 035059) Period of Study: 5/1996-9/1998 Location: Sao Paulo, Brazil	ED Visits Health Outcome (ICD10): Chronic lower respiratory disease (CLRD: J40-47) for chronic bronchitis, emphysema, other COPD, asthma, and bronchiectasia Study Design: Time series Statistical Analyses: Poisson GAM, LOESS	Pollutant: CO Averaging Time: Max 8-h avg Mean (SD) unit: 3.7 (1.7) ppm Range (Min, Max): (1.0, 12.6) Copollutant: correlation NO ₂ : r = 0.62; SO ₂ : r = 0.51; PM ₁₀ : r = 0.73; O ₃ : r = 0.07	Increment: 1.63 ppm β (SE); lag: Chronic Lower Respiratory Diseases Age Group >64: 0.0489 (0.0274); 2
	Age Groups Analyzed: >64 yr		
Author: Masjedi et al. (2003, 052100) Period of Study: 9/1997-2/1998 Location: Tehran, Iran	ED Visits Health Outcome (ICD9): Total acute respiratory conditions; asthma (493); COPD (490-492, 494, 496) Study Design: Time series Statistical Analyses: Multiple step-wise regression	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 8.85 ppm Range (Min, Max): (2.15, 23.8) Copollutant: NR	Increment: NR β (p-value); lag: Asthma: -0.779 (0.12) COPD: 0.012 (0.71) Acute Respiratory conditions: -0.086 (0.400) Correlation coefficients: Mean 3-day CO levels and asthma: -0.300 (0.149) Mean weekly CO level and asthma: -0.14 (0.2) Mean 10-day CO levels and asthma: -0.05 (0.43)
	Age Groups Analyzed: Adults		
Author: McGowan et al. (2002, 030325) Period of Study: 6/1988- 12/1998 Location: Christchurch, New Zealand	Hospital Admissions Health Outcome (ICD9): Pneumonia (480-487); acute respiratory infections (460-466); chronic lung diseases (491-492, 494-496); asthma (493) Study Design: Time series Statistical Analyses: Generalized Additive Model	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.16 (1.51) mg/m ³ Range (Min, Max): (0, 15.7) Copollutant: NR	This study did not provide quantitative results for CO.
	Age Groups Analyzed: <15 yr; >64 yr		
Author: Migliaretti et al. (2007, 193772) Period of Study: 1/1997-12/1999 Location: Turin, Italy	Hospital Admissions Health Outcome (ICD9): Respiratory illness (chronic bronchitis, emphysema, and other COPD) (490-496) Study Design: Case control Statistical Analyses: Multiple logistic regression	Pollutant: CO Averaging Time: 8-h median Median (SD) unit: 3.36 (1.57) mg/m ³ Range (Min, Max): NR Copollutant: correlation TSP	Increment: 1 mg/m ³ Odds Ratio (Lower CI, Upper CI); lag: CO Age Group ≥ 15: 1.053 (1.030-1.070) 15-64: 1.040 (0.987-1.085) >64: 1.054 (1.027-1.083) CO, TSP Age Group ≥ 15: 1.058 (1.024-1.096) 15-64: 1.062 (0.993-1.135) >64: 1.054 (1.011-1.099)
	Age Groups Analyzed: ≥ 15 yr 15-64 yr >64 yr		

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Moolgavkar (2000, 010274) Period of Study: 1987-1995 Location: 3 U.S. counties: Los Angeles County, CA; Cook County, IL; Maricopa County, AZ	Hospital Admissions Health Outcome (ICD9): COPD plus asthma (490-496) Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: All Ages; 0-19 yr; 20-64 yr; ≥ 65 yr	Pollutant: CO Averaging Time: 24-h median Median unit: Cook: 993 ppb; LA: 1347 ppb; Maricopa: 1240 ppb Range (Min, Max): Cook: (224, 3912); LA: (237, 5955); Maricopa: (269, 4777) Copollutant: correlation Cook County: NO_2 : r = 0.63; SO_2 : r = 0.35; O_3 : r = -0.28 LA County: NO_2 : r = 0.80; SO_2 : r = 0.78; O_3 : r = -0.52 Maricopa County: NO_2 : r = 0.66; SO_2 : r = 0.53; O_3 : r = -0.61	Increment: 1.0 ppm % Increase (t-statistic); lag: Age Group: ≥ 65 Cook County CO: 2.60 (1.9); 0; / 3.00 (2.2); 1; / 1.30 (1.0); 2; 1.40 (1.1); 3; / 1.10 (0.8); 4; / 2.30 (1.8); 5 Los Angeles County CO: 5.40 (11.3); 0; / 4.90 (10.1); 1; / 5.00 (10.2); 2; 4.90 (10.1); 3; / 4.00 (8.3); 4; / 4.30 (8.6); 5; CO, PM_{10} : 4.30 (3.3); 0; / 5.30 (4.2); 1; / 5.10 (4.0); 2; 6.80 (5.6); 3; / 6.90 (5.4); 4; / 6.30 (4.7); 5; CO, $\text{PM}_{2.5}$: 3.00 (1.9); 0; / 3.90 (2.5); 1; / 4.20 (2.6); 2; 6.50 (4.4); 3; / 5.80 (3.8); 4; / 5.10 (3.1); 5 Maricopa County CO: 1.40 (1.0); 0; / 0.80 (0.6); 1; / 1.20 (0.9); 2; 1.20 (0.9); 3; / 1.50 (1.1); 4; / 4.90 (3.8); 5 Age Group: 0-19 Los Angeles County CO: 8.20 (14.4); 0; / 9.00 (15.9); 1; / 9.20 (16.4); 2; 8.50 (15.0); 3; / 7.00 (12.1); 4; / 4.80 (8.1); 5; CO, PM_{10} : 7.50 (14.4); 0; / 7.40 (5.2); 1; / 6.40 (4.3); 2; 8.00 (5.5); 3; / 6.30 (4.0); 4; / 5.30 (3.5); 5; CO, $\text{PM}_{0.25}$: 5.70 (3.4); 0; / 7.50 (4.9); 1; / 5.60 (3.3); 2; 5.40 (3.5); 3; / 4.40 (2.7); 4; / 1.80 (1.1); 5 Age Group: 20-64 Los Angeles County CO: 3.70 (8.6); 0; / 3.90 (9.1); 1; / 4.50 (10.6); 2; 3.50 (8.3); 3; / 3.40 (7.9); 4; / 3.50 (7.9); 5; CO, PM_{10} : 5.00 (4.6); 0; / 3.00 (2.7); 1; / 3.10 (2.8); 2; 5.20 (4.7); 3; / 5.90 (5.1); 4; / 4.90 (4.4); 5; CO, $\text{PM}_{2.5}$: 3.50 (2.5); 0; / 0.60 (0.4); 1; / 1.10 (0.8); 2; 5.70 (4.1); 3; / 4.70 (3.3); 4; / 3.90 (2.8); 5; CO, $\text{PM}_{0.25}$: 2.80 (2.2); 0; / 2.50 (2.0); 1; / 0.60 (0.5); 2; 3.90 (3.2); 3; / 3.40 (2.8); 4; / 4.00 (3.4); 5
Author: Moolgavkar (2003, 042864) Period of Study: 1987-1995 Location: 2 U.S. counties: Los Angeles County, CA, and Cook County, IL	Hospital Admissions Health Outcome (ICD9): COPD plus asthma (490-496) Study Design: Time series Statistical Analyses: Poisson GAM, Poisson GLM with natural splines Age Groups Analyzed: All Ages; ≥ 65 yr	Pollutant: CO Averaging Time: 24-h median Median unit: Cook: 993 ppb; LA: 1347 ppb; Maricopa: 1240 ppb Range (Min, Max): Cook: (224, 3912); LA: (237, 5955) Copollutant: correlation Cook County: NO_2 : r = 0.63; SO_2 : r = 0.35; O_3 : r = -0.28 Los Angeles County: NO_2 : r = 0.80; SO_2 : r = 0.78; O_3 : r = -0.52	Increment: 1 ppm % Increase (t-statistic); lag: COPD-Los Angeles County CO: GAM-30 (10-8): 5.48 (17.67); 0; / 5.67 (18.22); 1; / 5.90 (19.01); 2; 5.28 (16.94); 3; / 4.59 (14.50); 4; / 4.10 (12.80); 5 GAM-100 (10-8): 2.37 (8.67); 0; / 2.41 (8.73); 1; / 2.41 (8.76); 2; 1.81 (6.58); 3; / 1.38 (4.94); 4; / 1.07 (3.82); 5 NS-100: 2.28 (5.65); 0; / 2.29 (5.50); 1; / 2.32 (5.33); 2; 1.74 (4.10); 3; / 1.30 (3.16); 4; / 1.00 (2.46); 5 COPD-Cook County CO: GAM-100 (10-8): 2.11 (1.62); 0; / 2.85 (2.16); 1; / 1.14 (0.86); 2; 1.05 (0.79); 3; / 0.43 (0.33); 4; / 0.34 (0.26); 5

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Neidell et al. (2004, 057330)	Hospital Admissions	Pollutant: CO	Increment: NR
Period of Study: 1992-1998	Health Outcome (ICD9): Asthma (493)	Averaging Time: 24-h avg	β (SE); lag;
Location: California	Study Design: Time series	Mean (SD) unit: 1.777 (1.037) ppm	Single-pollutant model
	Statistical Analyses: Linear Regression	Range (Min, Max): NR	Age Group
	Age Groups Analyzed: 0-1 yr 1-3 yr 3-6 yr 6-12 yr 12-18 yr	Copollutant: correlation O_3 PM_{10} NO_2	0-1: -0.007 (0.009); 1-3: 0.027 (0.009); 3-6: 0.053 (0.010); 6-12: 0.047 (0.009); 12-18: 0.025 (0.008) Fixed effect controlling for O_3 , PM_{10} , and NO_2
			Age Group 0-1: -0.01 (0.01); 1-3: 0.024 (0.011); 3-6: 0.049 (0.011); 6-12: 0.023 (0.011); 12-18: 0.021 (0.009) Fixed effect controlling for O_3 , PM_{10} , NO_2 and avoidance behavior
			Age Group 0-1: -0.010 (0.010); 1-3: 0.027 (0.011); 3-6: 0.051 (0.011); 6-12: 0.025 (0.011); 12-18: 0.021 (0.009)
Author: Norris et al. (1999, 040774)	ED Visits	Pollutant: CO	Increment: 0.6 ppm
Period of Study: 9/1995- 12/1996	Health Outcome (ICD9): Asthma (493)	Averaging Time: 24-h avg	Relative Risk (Lower CI, Upper CI); Lag
Location: Seattle, WA	Study Design: Time series	Mean (SD) unit: 1.6 (0.5) ppm	High Utilization: 1.04 (0.93-1.16); 1
	Statistical Analyses: Semiparametric Poisson GAM	Range (Min, Max): (0.6, 4.1)	Low Utilization: 1.15 (1.05-1.28); 1
	Age Groups Analyzed: <8 yr	Copollutant: correlation PM_{10} : r = 0.74 NO_2 (1-h max): r = 0.47 NO_2 (24-h avg.): r = 0.66 SO_2 (1-h max): r = 0.15 SO_2 (24-h avg.): r = 0.32	All: 1.10 (1.02-1.19); 1
Author: Peel et al. (2005, 056305)	ED Visits	Pollutant: CO	Increment: 1.0 ppm
Period of Study: 1/1993- 8/2000	Health Outcome (ICD9): Asthma (493, 786.09); COPD (491, 492, 496); URI (460-466, 477); pneumonia (480-486)	Averaging Time: 1-h max	Relative Risk (Lower CI, Upper CI); Lag
Location: Atlanta, GA	Study Design: Time series	Mean (SD) unit: 1.8 (1.2) ppm	Health Condition All respiratory illnesses: 1.011 (1.004-1.019); 0-2
	Statistical Analyses: 1. Poisson GEE or asthma, URI, all respiratory 2. Poisson GLM for pneumonia and COPD	Range (10th, 90th): (0.5, 3.4)	URI: 1.012 (1.003-1.021); 0-2 / 1.066 (1.045-1.087); 0-13
	Age Groups Analyzed: Primary Analysis: All Ages Secondary Analysis: 2-18 yr	Copollutant: NR	Asthma: 1.010 (0.999-1.022); 0-2 1.076 (1.047-1.105); 0-13 Pneumonia: 1.009 (0.996-1.021); 0-2 1.045 (1.011-1.080); 0-13 COPD: 1.026 (1.004-1.048); 0-2 1.032 (0.975-1.092); 0-13 RR for asthma and exposure to CO for children age 2-18: 1.019 (1.004-1.035); 0-2
			RR for all respiratory illnesses and CO exposure for all ages AQS (1/1/93- 8/31/00): 1.011 (1.004-1.019); 0-2 AQS (8/1/98- 8/31/00): 1.010 (1.000-1.021); 0-2 ARIES (8/1/98- 8/31/00): 1.018 (1.003-1.033); 0-2

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Sauerzapf et al. (2009, 180082) Period of Study: Jan 2006-Feb 2007 Location: Norfolk county, England	Hospital Admissions Health Outcome: COPD Study Design: Case crossover Statistical Analyses: Logistic Regression Age Groups Analyzed: 18+ yr (90% of patients 60+ yr) Sample Description: 1,050 COPD admissions	Averaging Time: 24 h Mean (SD) unit: Control days: 194.46 (80.93) Case days: 204.73 (119.97) Range (min, max): Control days: 105.20, 408.10 Case days: 108.70, 432.20 Copollutant: NO, NO ₂ , NO _x , O ₃ * Control days = 7 days prior to admission; Case days = day of admission	Increment: 10 µg/m ³ Lags examined: 0-8 OR Estimate [Lower CI, Upper CI]; lag: Unadjusted: 1.010 (1.001, 1.019); lag 0-7 Adjusted: 1.015 (1.005, 1.025); lag 0-7 Unadjusted: 1.013 (1.001, 1.025); lag 1-8 Adjusted: 1.018 (1.005, 1.031); lag 1-8
Author: Sheppard et al. (1999, 086921) Period of Study: 1987-1994 Location: Seattle, WA	Hospital Admissions Health Outcome (ICD9): Asthma (493) Study Design: Time series Statistical Analyses: Poisson Age Groups Analyzed: <65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1831 ppb IQR (25th, 75th): (1277, 2201) Copollutant: correlation PM ₁₀ : r = 0.83; PM _{2.5} : r = 0.78; PM _{10-2.5} : r = 0.56; O ₃ : r = -0.18; SO ₂ : r = 0.24	Increment: 924 ppb % Increase (Lower CI, Upper CI); Lag: CO: 6% (3, 9); 3 CO, PM _{2.5} : 5% (1, 8); 3
Author: Slaughter et al. (2005, 073854) Period of Study: 1/1995-6/2001 Location: Spokane, WA	Hospital Admissions & ED Visits Health Outcome (ICD9): Respiratory causes (460-519) Asthma (493); COPD (491, 492, 494, 496) acute respiratory tract infections not including colds and sinusitis (464-466, 490) Study Design: Time series Statistical Analyses: Poisson GLM, Natural Splines Age Groups Analyzed: All ages, Adults	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR Range (5th, 95th): (1.25, 3.05) Copollutant: correlation PM ₁ : r = 0.63 PM _{2.5} : r = 0.62 PM ₁₀ : r = 0.32 PM _{10-2.5} : r = 0.32	Increment: 1.0 ppm Relative Risk (Lower CI, Upper CI); lag: ED Visits All Respiratory Illnesses Age Group: All Ages: 0.99 (0.96-1.02); 1 / 1.01 (0.98-1.04); 2 1.03 (1.00-1.06); 3 Asthma Age Group: All Ages: 1.00 (0.95-1.06); 1 / 1.01 (0.96-1.07); 2 1.06 (1.00-1.11); 3 COPD Age Group: Adults: 0.92 (0.85-1.00); 1 / 0.99 (0.91-1.08); 2 1.01 (0.93-1.10); 3 Hospital Admissions: All Respiratory Illnesses Age Group: All Ages: 0.99 (0.95-1.02); 1 / 1.00 (0.96-1.04); 2 0.99 (0.96-1.03); 3 Asthma Age Group: All Ages: 1.02 (0.92-1.13); 1 / 1.06 (0.96-1.17); 2 1.00 (0.91-1.11); 3 COPD Age Group: Adults: 0.94 (0.86-1.03); 1 / 1.04 (0.95-1.13); 2 0.97 (0.88-1.06); 3

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Stieb et al. (2000, 011675) Period of Study: 7/1992- 3/1996 Location: Saint John, Canada	ED Visits Health Outcome (ICD9): Asthma; COPD; respiratory infections; all respiratory illnesses Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg 1-h max Mean (SD) unit: All yr: 0.5 (0.3) ppm May-September: 0.6 (0.3) ppm All yr: 1.6 (1.1) ppm, May-September: 1.7 (0.9) ppm Range (Min, Max): NR Copollutant: correlation H ₂ S: r = -0.10; NO ₂ : r = 0.68; O ₃ : r = -0.05; SO ₂ : r = 0.31; TRS: r = 0.07; PM ₁₀ : r = 0.28; PM _{2.5} : r = 0.27; H ₊ : r = 0.23; SO ₄ ²⁻ : r = 0.27; CoH: r = 0.55	Increment: 0.5 & 1.7 ppm All% Increase (Lower CI, Upper CI); lag: Respiratory illnesses Increment: 0.5 ppm All Year: -3.40; 7 Increment: 1.7 ppm May- September: -5.70
Author: Sun et al. (2006, 090768) Period of Study: 1/2004- 12/2004 Location: Taiwan	ED Visits Health Outcome (ICD9): Asthma (493) Study Design: Cross sectional Statistical Analyses: Pearson correlation analysis Age Groups Analyzed: <16 yr; 16-55 yr	Pollutant: CO Averaging Time: Monthly Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Increment: NR Correlation Coefficient: Asthma Age Group: <16: 0.653 16-55: 0.425
Author: Tenias et al. (2002, 026077) Period of Study: 1/1994- 12/1995 Location: Valencia, Spain	ED Visits Health Outcome (ICD9): COPD (491, 492, 494, 496) Study Design: Time series Statistical Analyses: 1. Poisson autoregressive 2. Sensitivity: GAM, LOESS Age Groups Analyzed: >14 yr	Pollutant: CO Averaging Time: 24-h avg 1-h max Mean (SD) unit: 24-h avg All yr: 3.1 mg/m ³ Warm Months: 2.5 mg/m ³ Cold Months: 3.7 mg/m ³ 1-h avg All yr: 6.7 mg/m ³ Warm Months: 5.4 mg/m ³ Cold Months: 8.0 mg/m ³ Range (Min, Max): 24-h avg: (0.9, 7.1) 1-h max: (1.6, 17.2) Copollutant: correlation SO ₂ : r = 0.734; NO ₂ : r = 0.180; O ₃ : r = -0.517	Increment: 1 mg/m ³ Relative Risk (Lower CI, Upper CI); Lag 24-h avg All Year: 1.074 (0.998- 1156); 1 Cold Months: 1.070 (0.991-1.156); 1 Warm Months: 1.129 (0.960-1.329); 1 1-h max All Year: 1.039 (1.014-1.066); 1 Cold Months: 1.037 (1.010-1.064); 1 Warm Months: 1.058 (0.994-1.127); 1 All Year: sinusoidal terms: 1.039 (1.010-1.066); 1 All Year: humidity and temperature variables: 1.040 (1.014-1.067); 1 All Year: GAM, LOESS: 1.042 (1.019-1.066); 1
Author: Thompson et al. (2001, 073513) Period of Study: 1/1993- 12/1995 Location: Belfast, Northern Ireland	ED Visits Health Outcome (ICD9): Asthma (493) Study Design: Time series Statistical Analyses: Poisson Age Groups Analyzed: Children	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Warm Season: 0.57 (0.41) ppm Cold Season: 0.74 (0.73) ppm IQR (25th, 75th): Warm Season: (0.3, 0.7) Cold Season: (0.4, 0.8) Copollutant: correlation SO ₂ (log): r = 0.64; PM ₁₀ (log): r = 0.57; O ₃ : r = -0.52; NO _x (log): r = 0.74; NO (log): r = 0.71; NO ₂ : r = 0.69	Increment: NR Relative Risk (Lower CI, Upper CI); lag: Temperature included in the model: 1.04 (1.00-1.09); 0 / 1.07 (1.02-1.12); 0-1 1.06 (1.00-1.12); 0-2 / 1.07 (1.00-1.14); 0-3 Warm Season: 1.06 (0.98-1.16); NR Cold Season: 1.07 (1.01-1.14); NR Adjusted for benzene level: 0.92 (0.83-0.92); 0-1 avg. Note: The increment the study uses to calculate effect estimates is a doubling in CO levels, but The study did not provide this value.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Tolbert et al. (2007, 090316) Period of Study: 1/1993- 12/2004 Location: Atlanta, GA	ED Visits Health Outcome (ICD9): Respiratory disease: asthma (493, 786.07, 786.09); COPD (491, 492, 496); URI (460-465, 460.0, 477); pneumonia (480-496); bronchiolitis (466.1, 466.11, 466.19)) Study Design: Time series Statistical Analyses: Poisson GLM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 1-h max Mean (SD) unit: 1.6 ppm Range (Min, Max): (0.1, 7.7) Copollutant: correlation PM ₁₀ : r = 0.51; O ₃ : r = 0.27; NO ₂ : r = 0.70; SO ₂ : r = 0.28; Coarse PM: r = 0.38; PM _{2.5} : r = 0.47; SO ₄ : r = 0.14; EC: r = 0.66; OC: r = 0.59; TC: r = 0.63; OHC: r = 0.29	Increment: 1.22 ppm Relative Risk (Lower CI, Upper CI); lag: Respiratory Diseases: 1.016 (1.009-1.022); 3 Note: The study only provides results of the multi-pollutant models in figures, not quantitatively.
Author: Trapasso and Keith (1999, 180127) Period of Study: 1/1994- 12/1994 Location: Bowling Green, KY	Hospital Admissions Health Outcome (ICD9): Asthma (493) Study Design: Time series Statistical Analyses: Spearman Rank Correlation Coefficient Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: NR Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Increment: NR Correlation Coefficient (lag) CO Mean: r = 0.19; 0 CO Mean: r = 0.27; 1 CO Mean: r = 0.21; 2 CO Max: r = 0.26; 0 CO Max: r = 0.36; 1 CO Max: r = 0.24; 2
Author: Tsai et al. (2006, 089768) Period of Study: 1996-2003 Location: Kaohsiung, Taiwan	Hospital Admissions Health Outcome (ICD9): Asthma (493) Study Design: Case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.77 ppm Range (Min, Max): (0.23, 1.72) Copollutant: PM ₁₀ SO ₂ NO ₂ O ₃	Increment: 0.29 ppm Odds Ratio (Lower CI, Upper CI); lag OR for getting asthma and exposure to various pollutants for all ages at either <25°C or ≥ 25°C CO <25°C: 1.414 (1.300-1.537); 0-2 ≥ 25°C: 1.222 (1.138-1.312); 0-2 CO, PM ₁₀ <25°C: 1.251 (1.125-1.393); 0-2 ≥ 25°C: 1.178 (1.088-1.274); 0-2 CO, SO ₂ <25°C: 1.207 (1.076-1.354); 0-2 ≥ 25°C: 1.290 (1.188-1.400); 0-2 CO, NO ₂ <25°C: 0.916 (0.807-1.039); 0-2 ≥ 25°C: 1.249 (1.127-1.384); 0-2 CO, O ₃ <25°C: 1.396 (1.282-1.520); 0-2 ≥ 25°C: 1.195 (1.113-1.284); 0-2
Author: Vigotti et al. (2007, 090711) Period of Study: 1/2000- 12/2000 Location: Pisa, Italy	ED Visits Health Outcome (ICD9): Respiratory disease: asthma (493); dry cough (468); acute bronchitis (466) Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: <10 yr; >65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.5 (0.7) ug/m ³ Range (Min, Max): (0.3, 3.5) Copollutant: correlation NO ₂ : r = 0.62 PM ₁₀ : r = 0.70	Increment: 1mg/m ³ % Increase (Lower CI, Upper CI); lag Age Group <10: 18.60% (-6.90 to 51.10); 1 >65: 26.50% (3.40-54.80); 4

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Villeneuve et al. (2006, 091179) Period of Study: 1995-2000 Location: Toronto, ON, Canada	Physician Visits Health Outcome (ICD9): Allergic rhinitis (177) Study Design: Time series Statistical Analyses: Poisson GLM Age Groups Analyzed: >65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.1 (0.4) ppm Range (Min, Max): (0.0, 2.2) Copollutant: PM _{2.5} PM ₁₀ PM _{0-2.5} SO ₂ NO ₂ O ₃	Increment: 0.4 ppm Odds Ratio (Lower CI, Upper CI); Lag The study did not present quantitative results for CO.
Author: Xirasagar et al. (2006, 093267) Period of Study: 1998- 2001 Location: Taiwan	Hospital Admissions Health Outcome (ICD9): Asthma (493) Study Design: Cross sectional Statistical Analyses: Spearman Rank Correlations Age Groups Analyzed: 0-14 yr; <2 yr; 2-5 yr; >5 yr	Pollutant: CO Averaging Time: Monthly Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Increment: NR Correlation Coefficient (Lag) Age Group: <2: r = -0.208 2-5: r = -0.281 >5: r = -0.134
Author: Yang et al. (2007, 092848) Period of Study: 1996-2003 Location: Taipei, Taiwan	Hospital Admissions Health Outcome (ICD9): Asthma (493) Study Design: Case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.33 ppm Range (Min, Max): (0.32, 3.62) Copollutant: PM ₁₀ SO ₂ NO ₂ O ₃	Increment: 0.53 ppm Odds Ratio (Lower CI, Upper CI); Lag CO <25°C: 1.076 (1.019-1.136); 0-2 ≥ 25°C: 1.277 (1.179-1.383); 0-2 CO, PM ₁₀ <25°C: 1.050 (0.983-1.122); 0-2 ≥ 25°C: 1.332 (1.216-1.459); 0-2 CO, SO ₂ <25°C: 1.131 (1.059-1.207); 0-2 ≥ 25°C: 1.278 (1.174-1.392); 0-2 CO, NO ₂ <25°C: 0.915 (0.839-0.997); 0-2 ≥ 25°C: 1.177 (1.049-1.320); 0-2 CO, O ₃ <25°C: 1.169 (1.102-1.240); 0-2 ≥ 25°C: 1.275 (1.177-1.382); 0-2
Author: Yang et al. (2007, 092847) Period of Study: 1996-2003 Location: Taipei, Taiwan	Hospital Admissions Health Outcome (ICD9): COPD: (490-492, 494, 496) Study Design: Case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.33 ppm Range (Min, Max): (0.32, 3.66) ppm Copollutant: PM ₁₀ SO ₂ NO ₂ O ₃	Increment: 0.53 ppm Odds Ratio (Lower CI, Upper CI); Lag CO <20°C: 0.975 (0.921,1.033); 0-2 ≥ 20°C: 1.227 (1.178-1.277); 0-2 CO, PM ₁₀ <20°C: 0.925 (0.863-0.992); 0-2 ≥ 20°C: 1.177 (1.123-1.235); 0-2 CO, SO ₂ <20°C: 0.895 (0.832-0.962); 0-2 ≥ 20°C: 1.274 (1.219-1.331); 0-2 CO, NO ₂ <20°C: 1.000 (0.910-1.099); 0-2 ≥ 20°C: 1.061 (0.998-1.129); 0-2 CO, O ₃ <20°C: 0.935 (0.875-0.999); 0-2 ≥ 20°C: 1.234 (1.185-1.285); 0-2

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Yang et al. (2005, 090184) Period of Study: 1/1994- 12/1998 Location: Vancouver, Canada	Hospital Admissions Health Outcome (ICD9): COPD (490-492, 494, 496) Study Design: Time series Statistical Analyses: Poisson Age Groups Analyzed: ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: .71 (0.28) ppm Range (Min, Max): (0.30, 2.48) Copollutant: correlation O ₃ : r = -0.56 NO ₂ : r = 0.73 SO ₂ : r = 0.67 PM ₁₀ : r = 0.50	Increment: 0.3 ppm Relative Risk (Lower CI, Upper CI); lag CO 1.03 (1.00-1.06); 0 / 1.04 (1.01-1.08); 0-1 1.05 (1.01-1.09); 0-2 / 1.05 (1.00-1.10); 0-3 1.06 (1.01-1.11); 0-4 / 1.07 (1.02-1.12); 0-5 1.08 (1.02-1.13); 0-6 MultiPollutant: CO, O ₃ : 1.11 (1.04-1.18); 0-6 CO, NO ₂ : 1.04 (0.95-1.14); 0-6 CO, SO ₂ : 1.11 (1.01-1.22); 0-6 CO, PM ₁₀ : 1.02 (0.93-1.12); 0-6 CO, PM ₁₀ , O ₃ , NO ₂ , SO ₂ : 1.08 (0.96-1.22); 0-6 CO, O ₃ , NO ₂ , SO ₂ : 1.10 (0.98-1.23); 0-6
Author: Yang et al. (2003, 055621) Period of Study: 1/1986- 12/1998 Location: Vancouver, BC, Canada	Hospital Admissions Health Outcome (ICD9): Respiratory diseases (460-519) Study Design: Case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: <3 yr; ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.98 (0.54) ppm IQR (25th, 75th): (0.62, 1.16) Copollutant: correlation O ₃ : r = -0.52 CoH NO ₂ SO ₂	Increment: 0.54 ppm Odds Ratio (Lower CI, Upper CI); lag OR for respiratory diseases and exposure to various pollutants for people <3 and ≥ 65 Age Group: <3 CO alone: 1.04 (1.01-1.07); 1 CO, O ₃ : 1.04 (1.01-1.07); 1 CO, O ₃ , CoH, NO ₂ , SO ₂ : 1.02 (0.96-1.08); 1 Age Group: ≥ 65 CO alone: 1.02 (1.00-1.04); 1 CO, O ₃ : 1.02 (1.00-1.04); 1 CO, O ₃ , CoH, NO ₂ , SO ₂ : 0.96 (0.93-1.00); 1
Author: Yang et al. (2004, 087488) Period of Study: 6/1/1995-3/31/1999 Location: Vancouver, Canada	Hospital Admissions Health Outcome (ICD9): Respiratory diseases (460-519); pneumonia (480-486); asthma (493) Study Design: Case control Statistical Analyses: Pearson's correlation coefficient Age Groups Analyzed: <3 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.70 (0.30) ppm IQR (25th, 75th): (0.50, 0.80) Copollutant: correlation PM ₁₀ : r = 0.46; PM _{2.5} : r = 0.24; PM _{10-2.5} : r = 0.33; O ₃ : r = -0.53; NO ₂ : r = 0.74; SO ₂ : r = 0.61	This study did not present quantitative results for CO.
Author: Zanobetti and Schwartz (2006, 090195) Period of Study: 1995-1999 Location: Boston, MA	Hospital Admissions Health Outcome (ICD9): Pneumonia (480-487) Study Design: Case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR IQR (25th, 75th): (0.39, 0.60) Copollutant: correlation PM _{2.5} : r = 0.52; BC: r = 0.82; NO ₂ : r = 0.67; O ₃ : r = -0.30	Increment: 0.475 ppm % Increase (Lower CI, Upper CI); lag: 5.45 (1.10, 9.51); 0 5.12 (0.83, 9.16); 0-1

Table C-6. Studies of long-term CO exposure and respiratory morbidity.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Goss et al. (2004, 055624)	Health Outcome: Lung function (FEV ₁ , cystic fibrosis pulmonary exacerbation) Study Design: Cohort Statistical Analyses: Logistic regression Population: 11,484 cystic fibrosis patients Age Groups Analyzed: >6 yr	Pollutant: CO Averaging Time: Annual avg Mean (SD) unit: 0.692 (0.295) ppm IQR (25th, 75th): (0.48, 0.83) Copollutant: NR	Increment: 1.0 ppm Odds Ratio (Lower CI, Upper CI); lag: Two or more pulmonary exacerbations during 2000 1.02 (0.85-1.22)
Author: Guo et al. (1999, 010937)	Health Outcome: Asthma Study Design: Cohort Statistical Analyses: Logistic regression Population: 331,686 nonsmoking children Age Groups Analyzed: Middle-school children (mean age = 13.8 yr)	Pollutant: CO Averaging Time: Annual avg Mean (SD) unit: 853 (277) ppb Range (Min, Max): (381, 1610) Copollutant: NR	Increment: 326 ppb % Increase (Lower CI, Upper CI); lag: Boys Physician-diagnosed asthma: 1.17% (0.63-1.72) Questionnaire-diagnosed asthma: 1.10% (0.45-1.75) Girls Physician-diagnosed asthma: 0.84% (0.45-1.22) Questionnaire-diagnosed asthma: 1% (0.44-1.56)

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Hirsch et al. (1999, 003537) Period of Study: Population: 9/1995-6/1996 Air: 4/1994-4/1995 Location: Dresden, Germany	Health Outcome: Asthma symptoms in the past 12 mo (wheeze, morning cough); Doctor's diagnosis (asthma, bronchitis); Lung function (bronchial hyperresponsiveness (BHR), FEV ₁ <85% pred., FEF _{25-75%} <70% pred.) Study Design: Cross sectional Statistical Analyses: Multiple logistic regression Population: 5-7: 2,796; 9-11: 2,625 Age Groups Analyzed: 5-7 and 9-11 yr	Pollutant: CO Averaging Time: Annual avg Mean (SD) unit: 0.69 mg/m ³ Range (Min, Max): (0.32, 1.54) Copollutant: NR	Increment: 0.2 µg/m ³ Prevalence Odds Ratio (Lower CI, Upper CI); lag: Symptoms in the past 12 mo: Wheeze Home Exposure Age Groups: 5-7: 9-11: 1.05 (0.93-1.18) Home/School Exposure Age Groups: 9-11: 1.02 (0.85-1.22) Morning Cough Home Exposure Age Groups: 5-7: 9-11: 1.12 (1.01-1.23) Age Group: 9-11: 1.13 (0.98-1.3) Doctor's diagnosis: Asthma Home Exposure Age Groups: 5-7: 9-11: 1.07 (0.94-1.21) Age Groups: 9-11: 1.16 (0.97-1.38) Doctor's diagnosis: Bronchitis Age Groups: 5-7: 9-11: 1.19 (1.11-1.27) Age Group: 9-11: 1.24 (1.12-1.38) Lung function: BHR Age Groups: 5-7: 9-11: 0.79 (0.63-0.99) Age Group: 9-11: 0.77 (0.6-0.99) Lung function: FEV1 <85% pred. Age Groups: 5-7: 9-11: 1.09 (0.81-1.47) Age Group: 9-11: 1.01 (0.73-1.41) Lung function: FEV25-75% <70% pred. Age Groups: 5-7: 9-11: 1.15 (0.94-1.39) Age Group: 9-11: 1.07 (0.86-1.34) Symptoms in the past 12 mo: Wheeze Age Groups: 5-7: 9-11 Atopic children: 1 (0.81-1.24) Nonatopic children: 1.05 (0.83-1.31) Morning cough Age Groups: 5-7: 9-11 Atopic children: 1.03 (0.82-1.29) Nonatopic children: 1.22 (1.05-1.41) Doctor's diagnosis: Asthma Atopic children: 1.05 (0.83-1.32) Nonatopic children: 1.29 (1.05-1.59) Doctor's diagnosis: Bronchitis Age Groups: 5-7: 9-11 Atopic children: 1 (0.86-1.16) Nonatopic children: 1.21 (1.1-1.33)
Author: Hwang et al. (2006, 088971) Period of Study: 2001 Location: Taiwan	Health Outcome: Allergic rhinitis Study Design: Cross sectional Statistical Analyses: Two-stage hierarchical model (logistic and linear regression) Population: 32,143 Taiwanese school children Age Groups Analyzed: 6-15 yr	Pollutant: CO Averaging Time: Annual avg Mean (SD) unit: 664 (153) ppb Range (Min, Max): (416, 964) Copollutant: correlation NO _x : r = 0.88 O ₃ : r = -0.37 PM ₁₀ : r = 0.27 SO ₂ : r = 0.40	Increment: 100 ppb Adjusted Odds Ratio (Lower CI, Upper CI); lag: Physician-diagnosed allergic rhinitis 1.05 (1.04-1.07) CO, SO ₂ : 1.04 (1.02-1.06) CO, PM ₁₀ : 1.05 (1.03-1.07) CO, O ₃ : 1.07 (1.05-1.09) Male: 1.06 (1.03-1.08); Female: 1.05 (1.02-1.08) Parental atopy: Yes: 1.05 (1.02-1.08) Parental atopy: No: 1.06 (1.03-1.08) Parental Education: <6: 1 (0.91-1.09) Parental Education: 6-8: 1.07 (1.02-1.12) Parental Education: 9-11: 1.05 (1.02-1.08) Parental Education: ≥ 12: 1.06 (1.03-1.09) ETS: Yes: 1.06 (1.03-1.08); ETS: No: 1.05 (1.02-1.08) Visible Mold: Yes: 1.07 (1.03-1.11) Visible Mold: No: 1.05 (1.03-1.07)

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Hwang et al. (2005, 089454)	Health Outcome: Asthma Study Design: Cross sectional Period of Study: 2001 Location: Taiwan	Pollutant: CO Averaging Time: Annual avg Mean (SD) unit: 664 (153) ppb Range (Min, Max): (416, 964) Copollutant: correlation NO _x : r = 0.88 O ₃ : r = -0.37 PM ₁₀ : r = 0.27 SO ₂ : r = 0.40	Increment: 100 ppb Adjusted Odds Ratio (Lower CI, Upper CI); lag: Physician-diagnosed asthma: 1.045 (1.017-1.074) CO, SO ₂ : 1.066 (1.034-1.099) CO, PM ₁₀ : 1.079 (1.047-1.112) CO, O ₃ : 1.063 (1.1-1.474) CO, SO ₂ , O ₃ : 1.111 (1.074-1.15) CO, PM ₁₀ , O ₃ : 1.119 (1.084-1.155) Male: 1.49 (1.37-1.63); Female: 1 Parental atopy: Yes: 1 Parental atopy: No: 2.72 (2.5-2.97) Parental Education: <6: 1 Parental Education: 6-8: 1.17 (0.9-1.52) Parental Education: 9-11: 1.61 (1.26-2.05) Parental Education: ≥ 12: 2.43 (1.9-3.09) ETS: Yes: 0.85 (0.78-0.92); ETS: No: 1 Visible Mold: Yes: 1.27 (1.16-1.4); Visible Mold: No: 1 Maternal smoking during pregnancy: Yes: 1.18 (0.89-1.56) Maternal smoking during pregnancy: No: 1 Cockroaches noted monthly: Yes: 1.15 (1.03-1.29) Cockroaches noted monthly: No: 1 Water damage: Yes: 0.96 (0.81-1.12) Water damage: No: 1
Author: Lee et al. (2003, 049201)	Health Outcome: Allergic rhinitis Study Design: Cohort Period of Study: 10/1995-5/1996 Location: Taiwan	Pollutant: CO Averaging Time: Annual avg Mean (SD) unit: 853 (277) ppb Range (Min, Max): (381, 1610) Copollutant: NR	The study did not present quantitative results for CO.
Author: Meng et al. (2007, 093275)	Health Outcome: Asthma Study Design: Cohort Period of Study: 11/2000-9/2001 Location: Los Angeles County and San Diego County, California	Pollutant: CO Averaging Time: Annual avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant: correlation Traffic: r = -0.04; O ₃ : r = -0.55; PM ₁₀ : r = 0.42; PM _{2.5} : r = 0.52; NO ₂ : r = 0.55	The study did not present quantitative results for CO.
	Age Groups Analyzed: 12-14 yr		

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Mortimer et al. (2008, 122163) Period of Study: 1989-2000 Location: San Joaquin Valley, CA Health Outcome: Lung function (FVC, FEV ₁ , PEF, FEF25-75, FEV ₁ /FVC, FEF25-75/FVC, FEF25, FEF75) Study Design: Cohort Statistical Analyses: 1. DSA algorithm 2. GEE Population: 232 asthmatic children Age Groups Analyzed: 6-11 yr	Pollutant: CO Averaging Time: 8-h max monthly mean Mean (SD) unit: NR Range (Min, Max): NR Copollutant: correlation: Lifetime NO ₂ (24-h avg): r = 0.68 O ₃ (8-h max): r = -0.40 PM ₁₀ (24-h avg): r = 0.05 Prenatal CO (8-h max): r = 0.52 NO ₂ (24-h avg): r = 0.37 O ₃ (8-h max): r = -0.16 PM ₁₀ (24-h avg): r = -0.05	Increment: NR Effect Size per IQR Increase in Pollutant (SE): FEF25-75: 24-h avg CO exposure during 1st trimester 0.90% (0.0113) FEV ₁ /FVC Daily max CO exposure during ages 0 to 3 -2.50% (0.0016) FEF25-75/FVC 24-h avg CO exposure during ages 0 to 6 and diagnosed with asthma <2 yr old -4.80% (0.0446) FEF25 24-h avg CO exposure during ages 0 to 6 and diagnosed with asthma <2 yr old plus 24-h avg PM ₁₀ exposure during 2nd trimester and mother smoked when pregnant -6.70% (0.015) Coefficient (SE): FVC 24-h avg CO exposure during 2nd trimester -0.0878 (0.0415) FEF25-75 Lifetime 24-h avg CO exposure -0.94454 (0.3975) FEF25-75/FVC -0.1090 (0.0303) FEV ₁ /FVC Prenatal 8-h max CO exposure: 0.1711 (0.0653) Lifetime 1-h max CO exposure: -0.3242 (0.0919) 24-h avg CO exposure during ages 0-3 and diagnosed with asthma <2 yr old: -0.1814 (0.0599) FEF25 24-h avg CO exposure during ages 0-6 and diagnosed with asthma <2 yr old: -1.0460 (0.1953) FEF75 Lifetime 8-h max CO exposure: -0.4214 (0.1423)	
Author: Singh et al. (2003, 052686) Period of Study: NR Location: Jaipur, India Health Outcome: Lung function Study Design: Panel study Statistical Analyses: Parametric statistical methods Population: Campus panel: 142 Commuter panel: 158 Age Groups Analyzed: ~20 yr	Pollutant: CO Averaging Time: Annual avg Mean (SD) unit: Roadside: 3,175 µg/m ³ Campus: 2,150 µg/m ³ Range (Min, Max): NR Copollutant: NR	The study did not present quantitative results for CO.	

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Sole et al. (2007, 090706)	Health Outcome: Symptoms of asthma, rhinitis, and eczema Study Design: Panel Statistical Analyses: Logistic Regression Age Groups Analyzed: 13-14 yr Location: Sao Paulo West, Sao Paulo South, Santo Andre, Curitba, & Porto Alegre, Brazil	Averaging Time: Annual Mean (SD) unit: Sao Paulo West: 7.70 ppm Sao Paulo South: 7.50 ppm Santo Andre: 9.80 ppm Curitba: 7.90 ppm Porto Alegre: 1.51 ppm Range (min, max): NR Copollutant: NO ₂ , SO ₂ , O ₃	Increment: Risk in relation to center w/ lowest annual mean (Porto Alegre = ref) OR Estimate [Lower CI, Upper CI]: Lags examined: NR Current Wheezing: Sao Paulo West: 1.26 (1.11, 1.42) Sao Paulo South: 1.03 (0.91, 1.18) Santo Andre: 1.36 (1.20, 1.56) Curitba: 1.05 (0.93, 1.19) Severe Asthma: Sao Paulo West: 1.20 (0.95, 1.50) Sao Paulo South: 0.59 (0.45, 0.78) Santo Andre: 0.62 (0.48, 0.81) Curitba: 0.64 (0.50, 0.82) Nighttime Coughing: Sao Paulo West: 1.06 (0.95, 1.17) Sao Paulo South: 0.93 (0.84, 1.03) Santo Andre: 0.91 (0.82, 1.02) Curitba: 0.99 (0.89, 1.10) Rhinoconjunctivitis: Sao Paulo West: 1.31 (1.15, 1.15) Sao Paulo South: 0.73 (0.64, 0.85) Santo Andre: 0.85 (0.74, 0.97) Curitba: 1.10 (0.96, 1.25) Severe Rhinits: Sao Paulo West: 1.01 (0.91, 1.49) Sao Paulo South: 0.68 (0.59, 0.77) Santo Andre: 0.73 (0.64, 0.83) Curitba: 1.03 (0.91, 1.16) Eczema: Sao Paulo West: 1.45 (1.20, 1.74) Sao Paulo South: 1.03 (0.85, 1.25) Santo Andre: 1.03 (0.85, 1.25) Curitba: 0.90 (0.75, 1.10) Flexural Eczema: Sao Paulo West: 1.42 (1.15, 1.76) Sao Paulo South: 0.71 (0.56, 0.91) Santo Andre: 0.68 (0.53, 0.87) Curitba: 0.73 (0.57, 0.92) Severe Eczema: Sao Paulo West: 1.08 (0.86, 1.35) Sao Paulo South: 0.42 (0.31, 0.56) Santo Andre: 0.38 (0.28, 0.51) Curitba: 0.30 (0.22, 0.41)
Author: Wang et al. (1999, 008105)	Health Outcome: Asthma Study Design: Cross sectional Statistical Analyses: Multiple logistic regression Location: Kaohsiung and Pintong, Taiwan	Pollutant: CO Averaging Time: Annual median Median (SD) unit: 0.80 ppm Range (Min, Max): NR Population: 165,173 high school students Age Groups Analyzed: 11-16 yr	Increment: NR Adjusted Odds Ratio (Lower CI, Upper CI); lag: CO Concentrations: <0.80 ppm: 1.0 CO Concentrations ≥ 0.80 ppm: 1.23 (1.19-1.28) Multivariate analysis with variables for exercise, smoking, alcohol, incense use, ETS: 1.15 (1.1-1.2)
Author: Wilhelm et al. (2008, 191912)	Health Outcome: Asthma symptoms/ED visit/HA Study Design: Panel Statistical Analyses: Logistic regression Location: Los Angeles County or San Diego County, California	Averaging Time: annual Mean (SD) unit: 1.0 ppm Range (min, max): 0.34, 1.8 Copollutant: correlation O ₃ ; r= -0.67 PM ₁₀ ; r= 0.41 PM _{2.5} ; r= 0.60 NO ₂ ; r= 0.57 traffic density; r= 0.02 Sample Description: 612 children who reported a physician diagnosis of asthma at some point in their lives	Increment: NR OR Estimate [Lower CI, Upper CI] ; lag: Lags examined: NR No associations observed between asthma symptom outcome measures (no results shown)

Table C-7. Studies of short-term CO exposure and mortality.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Anderson et al. (2001, 017033) Period of Study: 10/1994-12/1996 Location: West Midlands, United Kingdom	Health Outcome (ICD9): Mortality: All-cause (nonaccidental) (<800); cardiovascular (390-459); respiratory (460-519) Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: Max 8-h ma Mean (SD) unit: 0.8 (0.7) ppm Range (Min, Max): (0.2, 10.0) Copollutant correlation: PM_{10} : r = 0.55; $PM_{2.5}$: r = 0.54; $PM_{10-2.5}$: r = 0.10; BS: r = 0.77; SO_4^{2-} : r = 0.17; NO_2 : r = 0.73; O_3 : r = -0.29; SO_2 : r = 0.49	Increment: 1.0 ppm % Increase (Lower CI, Upper CI); lag: All-cause 0.8% (-0.6 to 2.2); 0-1 Cardiovascular 2.5% (0.4-4.6); 0-1 Respiratory 1.2% (-2.1 to 4.6); 0-1
Author: Bellini et al. (2007, 097787) Period of Study: 1996-2002 Location: 15 Italian cities	Health Outcome (ICD9): Mortality: All-cause (nonaccidental) (<800); cardiovascular (390-459); respiratory (460-519) Study Design: Meta-analysis Statistical Analyses: Poisson GLM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant: SO_2 NO_2 O_3 PM_{10}	Increment: 1 mg/m ³ % Increase (Lower CI, Upper CI); lag: All-cause 1.19% (0.61-1.72); 0-1 Respiratory 0.66% (-1.46 to 2.88); 0-1 Cardiovascular 0.93% (-0.10 to 1.77); 0-1
Author: Berglind et al. (2009, 190068) Period of Study: 1992-2002 Location: Augsburg, Germany; Barcelona, Spain; Helsinki, Finland; Rome, Italy; Stockholm, Sweden	Health Outcome: Mortality Study Design: Cohort Statistical Analyses: Poisson regression analysis Age Groups Analyzed: ≥ 35 yr Sample Description: First-time MI patients	Averaging Time: 24 h Mean (SD) unit: Median calculated from daily 24-h means: Augsburg: 0.85 Barcelona: 0.75 Helsinki: 0.36 Rome: 1.66 Stockholm: 0.38 Range (IQR): Augsburg: 0.43 Barcelona: 0.75 Helsinki: 0.36 Rome: 1.11 Stockholm: 0.38 Copollutant: NR	Increment: 0.2 mg/m ³ % Change in Daily Nontrauma Deaths [Lower CI, Upper CI]: Mean of Lag 0 and 1: 2.61 (-0.26-5.56) Mean of Lag 0-4: 3.82 (1.00-6.72) Mean of Lag 0-14: 4.92 (2.11-7.81) Lags examined: 0, 1, 4, 14 CO had a trend towards or positive associations with all cities for 2-day mean effects on daily mortality. CO was associated with risk for the 5-day avg. The strongest association was observed for the 15-day avg.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Biggeri et al. (2005, 087395) Period of Study: 1990-1999 Location: 8 Italian Cities (Turin, Milan, Verona, Bologna, Ravenna, Florence, Rome, and Palermo)	Health Outcome (ICD9): Mortality: All-cause (nonaccidental) (<800); cardiovascular (390-459); respiratory (460-519); cardio-respiratory Study Design: Meta-analysis Statistical Analyses: Poisson GLM, cubic splines Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: Max 8-h ma Mean (SD) unit: Turin, 1991-1994: 5.8 mg/m ³ Turin, 1995-1998: 4.0 mg/m ³ Milan, 1990-1994: 5.9 mg/m ³ Milan, 1995-1997: 4.0 mg/m ³ Verona, 1995-1999: 2.5 mg/m ³ Ravenna, 1991-1995: 1.8 mg/m ³ Bologna, 1996-1998: 2.4 mg/m ³ Florence, 1996-1998: 2.7 mg/m ³ Rome, 1992-1994: 6.5 mg/m ³ Rome, 1995-1997: 5.4 mg/m ³ Palermo, 1997- 1999: 2.1 mg/m ³ Range (Min, Max): Turin, 1991-1994: (NR, 24.7) Turin, 1995-1998: (NR, 19.8) Milan, 1990-1994: (NR, 26.5) Milan, 1995-1997: (NR, 12.3) Verona, 1995-1999: (NR, 10.2) Ravenna, 1991-1995: (NR, 7.0) Bologna, 1996-1998: (NR, 11.1) Florence, 1996-1998: (NR, 8.7) Rome, 1992-1994: (NR, 22.3) Rome, 1995-1997: (NR, 18.5) Palermo, 1997- 1999: (NR, 8.0) Copollutant: NR	Increment: 1.0 mg/m ³ % Increase (Lower CI, Upper CI); lag: Non-accidental Fixed: 0.93 (0.50-1.36); 0-1 Random: 0.93 (0.50-1.36); 0-1 Cardiovascular Fixed: 1.29 (0.62-1.96); 0-1 Random: 1.29 (0.62-1.96); 0-1 Respiratory Fixed: 2.44 (0.74-4.17); 0-1 Random: 2.47 (0.14-4.85); 0-1
Author: Botter et al. (2002, 011922) Period of Study: 1991-1993 Location: São Paulo, Brazil	Health Outcome (ICD9): Mortality Study Design: Longitudinal study Statistical Analyses: State space model Age Groups Analyzed: ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant: TSP; NO ₂ ; O ₃ ; SO ₂	Increment: NR β (SE): Model 1: 0.0053 (0.0036) Model 2: 0.0046 (0.0028) Model 3: 0.0040 (0.0028) Model 4: 0.0032 (0.0028)
Author: Bremner et al. (1999, 007601) Period of Study: 1/1992–12/1994 Location: London, U.K.	Health Outcome (ICD9): Mortality: All-cause (nonaccidental) (<800); cardiovascular (390-459); respiratory (460-519) Study Design: Time series Statistical Analyses: Poisson, cubic splines Age Groups Analyzed: All ages 0-64 yr ≥ 65 yr 65-74 yr ≥ 75 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.8 (0.4) ppm Range (Min, Max): (0.2, 5.6) Copollutant: NO ₂ ; O ₃ ; SO ₂ ; PM ₁₀ ; BS Age Group: All ages: 0.9% (-0.2 to 2.0); 1 0-64: 1.2% (-1.0 to 3.5); 1 ≥ 65: 0.8% (-0.4 to 1.9); 2 65-74: 0.8% (-1.2 to 2.8); 3 ≥ 75: 0.9% (-0.4 to 2.2); 2 Respiratory Age Group: All ages: 2.0% (-0.3 to 4.5); 3 0-64: 7.8% (0.2-15.9); 3 ≥ 65: 0.7% (-1.7 to 3.2); 3 65-74: 7.5% (2.1-13.2); 3 ≥ 75: 2.3% (-0.5 to 5.3); 0 Multipollutant: CO, SO ₂ : 1.90% (0.18-3.64); 3 CO, PM ₁₀ : 1.25% (0.04-2.47); 3 CO, BS: 2.41% (-0.65 to 5.57); 3 Cardiovascular Age Group: All ages: 1.4% (-0.1 to 3.0); 1 0-64: 2.1% (-1.7 to 6.0); 2 ≥ 65: 1.1% (-0.4 to 2.8); 2 65-74: 2.4% (-0.6 to 5.5); 2 ≥ 75: 1.9% (0.0-3.9); 2 Multipollutant: CO, NO ₂ : 2.55% (0.40-4.75); 1 CO, O ₃ : 3.98% (0.85-7.21); 1 CO, PM ₁₀ : 0.62% (-0.59 to 1.85); 1 CO, BS: 1.29% (-1.53 to 4.19); 1	Increment: 0.8 ppm % Increase (Lower CI, Upper CI); lag: All-cause Age Group: All ages: 0.9% (-0.2 to 2.0); 1 0-64: 1.2% (-1.0 to 3.5); 1 ≥ 65: 0.8% (-0.4 to 1.9); 2 65-74: 0.8% (-1.2 to 2.8); 3 ≥ 75: 0.9% (-0.4 to 2.2); 2 Respiratory Age Group: All ages: 2.0% (-0.3 to 4.5); 3 0-64: 7.8% (0.2-15.9); 3 ≥ 65: 0.7% (-1.7 to 3.2); 3 65-74: 7.5% (2.1-13.2); 3 ≥ 75: 2.3% (-0.5 to 5.3); 0 Multipollutant: CO, SO ₂ : 1.90% (0.18-3.64); 3 CO, PM ₁₀ : 1.25% (0.04-2.47); 3 CO, BS: 2.41% (-0.65 to 5.57); 3 Cardiovascular Age Group: All ages: 1.4% (-0.1 to 3.0); 1 0-64: 2.1% (-1.7 to 6.0); 2 ≥ 65: 1.1% (-0.4 to 2.8); 2 65-74: 2.4% (-0.6 to 5.5); 2 ≥ 75: 1.9% (0.0-3.9); 2 Multipollutant: CO, NO ₂ : 2.55% (0.40-4.75); 1 CO, O ₃ : 3.98% (0.85-7.21); 1 CO, PM ₁₀ : 0.62% (-0.59 to 1.85); 1 CO, BS: 1.29% (-1.53 to 4.19); 1

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Burnett et al. (2000, 010273) Period of Study: 1986-1996 Location: 8 Canadian cities	Health Outcome (ICD9): Mortality: All-cause (nonaccidental) (<800) Study Design: Time series Statistical Analyses: 1. Single-pollutant models: Poisson GAM, LOESS 2. Multi-pollutant models: Principal component regression analysis Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.9 ppm Range (Max): 7.2 ppm Copollutant: correlation O_3 : r = -0.05 SO_2 : r = 0.42 $PM_{2.5}$: r = 0.44 $PM_{10-2.5}$: r = 0.29 PM_{10} : r = 0.45	Increment: 0.9 ppm % Increase (t-value); lag: Temporally filtered daily nonaccidental mortality (days in which PM_{10} data available) CO: 0.4 (0.4); 0; 2.0 (2.3); 1 CO, $PM_{2.5}$: -0.7 (-0.7); 0; 1.1 (1.1); 1 CO, $PM_{10-2.5}$: 0.1 (0.2); 0; 1.8 (2.1); 1 CO, PM_{10} : -0.5 (-0.6); 0; 1.2 (1.3); 1 Daily filtered non-accidental mortality Single-pollutant model: 2.1 (2.1) Multi-pollutant models: Model 1: CO, $PM_{2.5}$, $PM_{10-2.5}$, O_3 , NO_2 , SO_2 : 0.7 (1.9) Model 2: CO, SO_4 , Ni, Fe, Zn, O_3 , NO_2 : 0.7 (1.7)
Author: Burnett et al. (2004, 086247) Period of Study: 1981-1999 Location: 12 Canadian cities	Health Outcome (ICD9): Mortality: All-cause (nonaccidental) (<800) Study Design: Time series Statistical Analyses: 1. Poisson, natural splines 2. Random effects regression model Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.02 ppm Range (Min, Max): NR Copollutant: NO_2 ; O_3 ; SO_2 ; $PM_{2.5}$; $PM_{10-2.5}$	Increment: 1.02 ppm % Increase (t-value); lag: 0.68% (3.12); 1 CO, NO_2 : 0.07% (0.30); 1
Author: Cakmak et al. (2007, 091170) Period of Study: 1/1997-12/2003 Location: Chile-7 cities	Health Outcome (ICD9): Mortality: All-cause (nonaccidental) (<800); CVDs (390-459); respiratory diseases (460-519) Study Design: Time series Statistical Analyses: Poisson; Random effects regression model Age Groups Analyzed: All ages ≤ 64 yr 65-74 yr 75-84 yr ≥ 85 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.29 ppm Range (Min, Max): NR Copollutant: correlation O_3 : r = -0.55 to -0.01 SO_2 : r = 0.31 to 0.67 PM_{10} : r = 0.49 to 0.82 Note: Correlations are between pollutants for seven monitoring stations.	Increment: 1.29 ppm % Increase (t-value); lag: Nonaccidental: 5.88% (6.42); 1; 9.39% (6.89); 0-5 $CO+PM_{10}+O_3+SO_2$: 6.13% (4.34); 1 Age Group: ≤ 64 4.10% (2.52); 1; / 4.76% (2.19); 0-5 Age Group: 65-74 6.24% (3.17); 1; / 8.12% (3.88); 0-5 Age Group: 75-84 8.64% (4.82); 1; / 13.12% (5.12); 0-5 Age Group: ≥ 85 8.58% (4.45); 1; / 13.20% (4.82); 0-5 April-September 7.09% (4.02); 1; / 9.65% (4.50); 0-5 October-March 5.45% (1.14); 1; / 7.80% (1.89); 0-5 Cardiac 7.79% (4.56); 1; / 11.22% (4.8); 0-5 Respiratory 12.93% (5.78); 1; / 21.31% (6.34); 0-5
Author: Chock et al. (2000, 010407) Period of Study: 1989-1991 Location: Pittsburgh, PA	Health Outcome (ICD9): Mortality: Respiratory (480-486, 490-496, 507); cardiovascular (390-448); influenza (487) Study Design: Time series Statistical Analyses: Poisson GAM; Cubic B-spline basis functions Age Groups Analyzed: All ages <75 yr >75 yr	Pollutant: CO Averaging Time: 1-h avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant: PM_{10} ; $PM_{2.5}$; O_3 ; SO_2 ; NO_2	Increment: NR β (SE); lag: Age Group: <75 CO alone: 0.0080 (1.56); 0 PM_{10} , CO: 0.0030 (0.48); 0 PM_{10} , NO_2 , CO: 0.0079 (1.14); 0 PM_{10} , O_3 , SO_2 , NO_2 , CO: 0.072 (1.02); 0 CO -0.00738 (-1.42); -3; / 0.00133 (0.23); -2; -0.00219 (-0.38); -1; / 0.00809 (1.48); 0; -0.00129 (-0.22); 1; / 0.00512 (0.90); 2; -0.00974 (-1.87); 3 CO , PM_{10} , O_3 , SO_2 , NO_2 -0.01103 (-1.48); -3; / -0.00097 (-0.13); -2; 0.00514 (0.67); -1; / 0.00853 (1.15); 0; -0.00404 (-0.52); 1; / -0.00296 (-0.39); 2; -0.00346 (-0.46); 3 Season CO Winter: 0.00539 (0.78); 0 Spring: 0.01655 (1.90); 0 Summer: 0.00155 (0.14); 0 Fall: 0.00797 (1.14); 0

Study	Design	Concentrations	Effect Estimates (95% CI)
		CO, PM ₁₀ Winter: -0.00563 (-0.50); 0 Spring: 0.01233 (0.99); 0 Summer: -0.00712 (-0.48); 0 Fall: 0.00661 (0.73); 0 CO, PM ₁₀ , O ₃ , SO ₂ , NO ₂ Winter: -0.01326 (-0.95); 0 Spring: 0.02501 (1.54); 0 Summer: 0.01874 (0.92); 0 Fall: 0.01011 (0.88); 0 Age Group:>75 CO Alone: -0.0035 (-0.67); 0 CO, PM ₁₀ : -0.0104 (-1.67); 0 CO, PM ₁₀ , NO ₂ : -0.0128 (-1.80); 0 CO, PM ₁₀ , O ₃ , SO ₂ , NO ₂ : -0.0144 (-1.99); 0 CO -0.00025 (-0.05); -3; / -0.00242 (-0.42); -2; -0.00238 (-0.41); -1; / -0.00302 (-0.54); 0; -0.00116 (-0.20); 1; / -0.00508 (-0.88); 2; -0.00251 (-0.48); 3 CO, PM ₁₀ , O ₃ , SO ₂ , NO ₂ -0.00123 (-0.17); -3; / -0.00876 (-1.13); -2; -0.00682 (-0.88); -1; / -0.01248 (-1.66); 0; -0.00672 (-0.86); 1; / -0.00181 (-0.23); 2; -0.00515 (-0.69); 3 Season CO Winter: -0.00304 (-0.43); 0 Spring: 0.00482 (0.54); 0 Summer: 0.01178 (1.07); 0 Fall: -0.01011 (-1.43); 0 CO, PM ₁₀ Winter: -0.02303 (-2.03); 0 Spring: -0.00517 (-0.40); 0 Summer: 0.00735 (0.50); 0 Fall: -0.01042 (-1.14); 0 CO, PM ₁₀ , O ₃ , SO ₂ , NO ₂ Winter: -0.03370 (-2.41); 0 Spring: -0.00652 (-0.39); 0 Summer: 0.01258 (0.61); 0 Fall: -0.01250 (-1.07); 0	

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Cifuentes et al. (2000, 010351) Period of Study: 1988-1996 Location: Santiago, Chile	Health Outcome (ICD9): Mortality: All causes (nonaccidental) (<800) Study Design: Time series Statistical Analyses: Poisson GAM, GAM with filtered variables & GLM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 1-h avg Mean (SD) unit: 2.5 ppb Range (5th, 95th): (0.6, 6.2) Copollutant correlation: PM _{2.5} : r = 0.80 PM _{10-2.5} : r = 0.47 SO ₂ : r = 0.62 NO ₂ : r = 0.65 O ₃ : r = -0.01	Increment: All yr: 2.5 ppm Winter: 3.6 ppm Summer: 1.3 ppm Relative Risk (t-ratio); Lag All Year CO: 1.041 (7.2); 0-1 CO, PM _{2.5} : 1.025 (3.5); 0-1 CO, PM _{10-2.5} : 1.035 (4.9); 0-1 CO, SO ₂ : 1.038 (6.0); 0-1 CO, NO ₂ : 1.026 (3.9); 0-1 CO, O ₃ : 1.036 (4.8); 0-1 Winter CO: 1.052 (5.9); 0-1 CO, PM _{2.5} : 1.025 (2.1); 0-1 CO, PM _{10-2.5} : 1.049 (4.3); 0-1 CO, SO ₂ : 1.049 (5.0); 0-1 CO, NO ₂ : 1.027 (2.6); 0-1 CO, O ₃ : 1.051 (4.4); 0-1 Summer CO: 1.053 (6.0); 0-1 CO, PM _{2.5} : 1.053 (5.3); 0-1 CO, PM _{10-2.5} : 1.053 (5.3); 0-1 CO, SO ₂ : 1.050 (5.2); 0-1 CO, NO ₂ : 1.047 (5.2); 0-1 CO, O ₃ : 1.042 (3.6); 0-1 All Year GAM model CO: 1.041 (7.2); 0-1 CO, PM _{2.5} , PM _{10-2.5} , SO ₂ , NO ₂ , O ₃ : 1.032 (4.6); 0-1 GAM Filtered Variables CO: 1.030 (4.3); 0-1 CO, PM _{2.5} , PM _{10-2.5} , SO ₂ , NO ₂ , O ₃ : 1.022 (2.4); 0-1 GLM CO: 1.023 (2.4); 0-1 CO, PM _{2.5} , PM _{10-2.5} , SO ₂ , NO ₂ , O ₃ : 1.013 (1.1); 0-1
Author: Conceicao et al. (2001, 016628) Period of Study: 1994-1997 Location: Sao Paulo, Brazil	Health Outcome (ICD9): Mortality: Respiratory diseases (460-519) Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: <5 yr	Pollutant: CO Averaging Time: Max 8-h ma Mean (SD) unit: Total: 4.4 (2.2) ppm 1994: 5.1 (2.4) ppm 1995: 5.1 (2.4) ppm 1996: 3.9 (2.0) ppm 1997: 3.7 (1.6) ppm Range (Min, Max): NR Copollutant: PM ₁₀ ; SO ₂ ; O ₃	Increment: NR β (SE); lag: CO: 0.0306 (0.0076); 2 CO, SO ₂ , PM ₁₀ , O ₃ : 0.0259 (0.0116); 2 Model 1: Pollutant concentration: 0.0827 (0.0077); 2 Model 2: 1+loess(time): 0.0285 (0.0074); 2 Model 3: 2+loess(temperature)+humidity: 0.0309 (0.0076); 2 Model 4: 3+nonrespiratory counts: 0.0306 (0.0076); 2 Model 5: 4+autoregressive parameters: 0.0292 (0.0118); 2
Author: De Leon et al. (2003, 055688) Period of Study: 1/1985-12/1994 Location: New York, NY	Health Outcome (ICD9): Mortality: Circulatory (390-459); cancer (140-239) Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: All ages <75 yr >75 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 2.45 ppm IQR (25th, 75th): (1.80, 2.97) Copollutant: PM ₁₀ ; O ₃ ; SO ₂ ; NO ₂	The study did not present quantitative results for CO.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Dominici et al. (2003, 056116) Period of Study: 1987-1994 Location: 90 U.S. cities (NMMAPS)	Health Outcome (ICD9): Mortality: All-cause (nonaccidental); cardiovascular; respiratory Study Design: Time series Statistical Analyses: 1. GAM with S-PLUS default convergence criteria 2. GAM with more stringent convergence criteria 3. Poisson GLM with natural cubic splines Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant: O ₃ ; NO ₂ ; SO ₂ ; CO	Increment: 1 ppm % Increase (Lower CI, Upper CI); Lag CO 0.08% (-0.18 to 0.34); 0 0.46% (0.18-0.73); 1 0.16% (-0.12 to 0.45); 2
Author: Fairley et al. (1999, 000896) Period of Study: 1989-1996 Location: Santa Clara, CA	Health Outcome (ICD9): Mortality: Respiratory; cardiovascular Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg; Max 8-h avg Median (SD) unit: 24-h avg: 1.4 (1.0) ppm Max 8-h avg: 2.1 (1.6) ppm Range (Min, Max): 24-h avg: (0.0, 7.6) Max 8-h avg: (0.2, 2.5) Copollutant: correlation PM ₁₀ : r = 0.609; PM _{2.5} : r = 0.435; PM _{10-2.5} : r = 0.326; COH: r = 0.736; NO ₂ : r = 0.270; SO ₄ : r = 0.146; O ₃ : r = -0.215	Increment: 2.2 ppm Relative Risk (Lower CI, Upper CI); lag: 1980-1986 CO: 1.04; 0; CO: 1.05; 1; CO, COH: 1.00; 1; CO, NO ₃ : 1.03; CO, NO ₃ , O ₃ , COH: 1.00 1989-1996 CO: 1.02; 0; CO: 1.04; 1; CO, PM _{2.5} : 0.98; CO, NO ₃ : 1.01; CO, NO ₂ , O ₃ , NO ₃ : 1.06 Respiratory mortality: CO: 1.08; 1 Cardiovascular mortality: CO: 1.04; 1
Author: Fischer et al. (2003, 043739) Period of Study: 1986-1994 Location: The Netherlands	Health Outcome (ICD9): Mortality: Nonaccidental (<800); pneumonia (480-486); COPD (490-496); cardiovascular (390-448) Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: <45 yr 45-64 yr 65-74 yr ≥ 75 yr	Pollutant: CO Averaging Time: 24-h avg Median (SD) unit: 406 µg/m ³ Range (Min, Max): (174, 2620) Copollutant: PM ₁₀ ; BS; O ₃ ; NO ₂ ; SO ₂	Increment: 1,200 µg/m ³ Relative Risk (Lower CI, Upper CI); lag: Cardiovascular Age Group: <45: 0.965 (0.750-1.240); 0-6 45-64: 1.029 (0.941-1.125); 0-6 65-74: 1.038 (0.972-1.108); 0-6 ≥ 75: 1.024 (0.984-1.065); 0-6 COPD Age Group: <45: 1.710 (0.852-3.435); 0-6 45-64: 1.181 (0.850-1.640); 0-6 65-74: 1.377 (1.147-1.654); 0-6 ≥ 75: 1.072 (0.963-1.193); 0-6 Pneumonia Age Group: <45: 0.927 (0.463-1.856); 0-6 45-64: 2.691 (1.509-4.800); 0-6 65-74: 1.118 (0.743-1.683); 0-6 ≥ 75: 1.230 (1.090-1.389); 0-6
Author: Forastiere et al. (2005, 086323) Period of Study: 1998-2000 Location: Rome, Italy	Health Outcome (ICD9): Mortality: IHD (410-414) Study Design: Time-stratified case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: >35 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 2.4 (1.0) mg/m ³ IQR (25th, 75th): (1.7, 2.9) Copollutant correlation: PNC: r = 0.89; PM ₁₀ : r = 0.34; NO ₂ : r = 0.54; SO ₂ : r = 0.52; O ₃ : r = 0.01	Increment: 1.2 mg/m ³ % Increase (Lower CI, Upper CI); lag: 6.5% (1.0-12.3); 0 4.7% (-0.9 to 10.7); 1 2.6% (-3.0 to 8.5); 2 -0.1% (-5.5 to 5.5); 3 7.0% (0.8-13.7); 0-1

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Forastiere et al. (2007, 090720) Period of Study: 1998-2001 Location: Rome, Italy	Health Outcome (ICD9): Mortality: Malignant neoplasms (140-208); diabetes mellitus (250); hypertensive (401-405); previous AMI (410, 412); IHD (410-414); conduction disorders of the heart (426); dysrhythmia (427); heart failure (428); cerebrovascular (430-438); peripheral artery disease (440-448); COPD (490-496) Study Design: Time-stratified case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: >35 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR IQR (25th, 75th): NR Copollutant: PM ₁₀ ; PM _{2.5} ; NO _x ; Benzene	This study did not present quantitative results for CO.
Author: Goldberg et al. (2001, 016548) Period of Study: 1984-1993 Location: Montreal, Quebec, Canada	Health Outcome (ICD9): Mortality: Upper respiratory diseases (472-478); acute upper respiratory diseases (460-465); acute lower respiratory (466, 480-487, 512, 513, 518, 519) Study Design: Time series Statistical Analyses: Poisson GAM; LOESS Age Groups Analyzed: <65 yr; ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.8 (0.5) ppm Range (Min, Max): (0.1, 5.1) Copollutant: TSP; PM ₁₀ ; PM _{2.5} ; Sulfates; COH; SO ₂ ; NO ₂ ; NO; O ₃	The study did not present quantitative results for CO.
Author: Goldberg et al. (2003, 035202) Period of Study: 1984-1993 Location: Montreal, Quebec, Canada	Health Outcome (ICD9): Mortality: CHF (428) Study Design: Time-series Statistical Analyses: Poisson GLM, natural splines Age Groups Analyzed: ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.8 (0.5) ppm Range (Min, Max): (0.1, 5.1) Copollutant: PM _{2.5} ; Sulfate; SO ₂ ; NO ₂ ; O ₃	Increment: 0.50 ppm % Increase (Lower CI, Upper CI); lag: Daily mortality from CHF -0.99% (-6.31 to 4.63); 0 0.12% (-5.29 to 5.84); 1 -1.38% (-8.81 to 6.66); 0-2 Daily mortality among persons classified as having CHF before death 2.10% (-0.24 to 4.49); 0 2.28% (-0.09 to 4.72); 1 2.86% (-0.46 to 6.29); 0-2
Author: Goldberg et al. (2006, 088641) Period of Study: 1984-1993 Location: Montreal, Quebec, Canada	Health Outcome (ICD9): Mortality: Diabetes (250) Study Design: Time series Statistical Analyses: Poisson, natural splines Age Groups Analyzed: ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.8 (0.5) ppm Range (Min, Max): (0.1, 5.1) Copollutant: PM _{2.5} ; Sulfate; SO ₂ ; NO ₂ ; O ₃	Increment: 0.50 ppm % Increase (Lower CI, Upper CI); lag: Daily mortality from diabetes 2.64% (-2.56 to 8.12); 0 6.54% (1.31-12.03); 1 8.08% (1.03-15.62); 0-2 Daily mortality among persons classified as having diabetes before death 1.15% (-1.69 to 4.07); 0 1.30% (-1.58 to 4.27); 1 2.63% (-1.42 to 6.85); 0-2
Author: Gouveia et al. (2000, 012132) Period of Study: 1991-1993 Location: Sao Paulo, Brazil	Health Outcome (ICD9): Mortality: Respiratory; cardiovascular; all other causes Study Design: Time series Statistical Analyses: Poisson Age Groups Analyzed: All ages ≥65 yr <5 yr	Pollutant: CO Averaging Time: Maximum 8-h moving avg Mean (SD) unit: 5.8 (2.1) ppm Range (Min, Max): (1.3, 16.2) Copollutant: PM ₁₀ ; SO ₂ ; NO ₂ ; O ₃	Increment: 5.1 ppm Relative Risk (Lower CI, Upper CI); lag: Age Group: All ages: All-causes: 1.012 (0.994-1.031); 0 Age Group: >65 All-causes: 1.020 (0.996-1.046); 0 Respiratory: 0.981 (0.927-1.037); 2 CVD: 1.041 (1.007-1.076); 0 Age Group: <5 Respiratory: 1.086 (0.950-1.238); 0 Pneumonia: 1.141 (0.962-1.321); 2

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Gwynn et al. (2000, 074109) Period of Study: 5/1988-10/1990 Location: Buffalo, NY	Health Outcome (ICD9): Mortality: Respiratory (466, 480-486); Circulatory (401-405, 410-414, 415-417); All non-accidental causes (<800) Study Design: Time-series Statistical Analyses: Poisson GLM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant correlation: H ₊ : r = 0.15; SO ₄ ²⁻ : r = 0.24; O ₃ : r = -0.23; SO ₂ : r = 0.11; NO ₂ : r = 0.65	Increment: NR β (SE); lag: Respiratory mortality: 0.032466 (0.053802); 0 Circulatory mortality: 0.039216 (0.026544); 3 Total mortality: 0.040214 (0.015205); 3
Author: Hoek et al. (2001, 016550) Period of Study: 1986-1994 Location: The Netherlands	Health Outcome (ICD9): Mortality: Heart failure (428); arrhythmia (427); cerebrovascular (430-436); thrombocytic (433, 434, 444, 452, 453); cardiovascular (390-448) Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant: O ₃ ; BS; PM ₁₀ ; SO ₂ ; NO ₂	Increment: 120 µg/m ³ Relative Risk (Lower CI, Upper CI); Lag Total CVD mortality: 1.026 (0.993-1.060); 0-6 MI and other IHD mortality: 1.050 (1.004-1.099); 0-6 Arrhythmia: 1.062 (0.937-1.203); 0-6 Heart failure mortality: 1.109 (1.012-1.216); 0-6 Cerebrovascular mortality: 1.066 (1.029-1.104); 0-6 Embolism, thrombosis: 1.065 (0.926-1.224); 0-6
Author: Hoek et al. (2000, 010350) Period of Study: 1986-1994 Location: The Netherlands	Health Outcome (ICD9): Mortality: Pneumonia (480-486); COPD (490-496); CVDs (CVD) (390-448) Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Netherlands: 457 µg/m ³ Four Major Cities: 589 µg/m ³ Range (Min, Max): Netherlands: (174, 2620) Four Major Cities: (202, 4621) Copollutant correlation: PM ₁₀ : r = 0.64; BS: r = 0.89; O ₃ : r = -0.48; NO ₂ : r = 0.89; SO ₂ : r = 0.65; SO ₄ ²⁻ : r = 0.55; NO ₃ ⁻ : r = 0.58	Increment: Single-day lag (1): 1,500 µg/m ³ Weekly avg (0-6): 1200 µg/m ³ Relative Risk (Lower CI, Upper CI); Lag CO Four Major Cities: 1.022 (0.995-1.050); 1 Four Major Cities: 1.044 (1.008-1.082); 0-6 Netherlands w/o Major Cities: 1.040 (1.020-1.060); 1 Netherlands w/o Major Cities: 1.051 (1.026-1.076); 0-6 avg Entire Netherlands: 1.035 (1.018-1.052); 1 Entire Netherlands: 1.046 (1.025-1.068); 0-6 CVD: 1.044 (1.012-1.077); 0-6 COPD: 1.194 (1.099-1.298); 0-6 Pneumonia: 1.276 (1.143-1.426); 0-6 Winter: 1.038 (1.013-1.063); 0-6 Summer: 1.199 (1.108-1.296); 0-6 Multi-pollutant model CO, PM ₁₀ Total mortality: 0.969 (0.914-1.028); 0-6 CVD: 1.005 (0.918-1.101); 0-6 BS, CO Total mortality: 0.980 (0.933-1.030); 0-6 CVD: 0.927 (0.860-0.999); 0-6 CO, SO ₄ ²⁻ Total mortality: 0.990 (0.951-1.030); 0-6 CVD: 0.999 (0.939-1.063); 0-6
Author: Honda et al. (2003, 193774) Period of Study: 1976-1990 Location: Tokyo, Japan	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800) Study Design: Time series Statistical Analyses: Poisson Age Groups Analyzed: ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Median (SD) unit: 1.6 ppm Range (Min, Max): (0, 6.8) Copollutant correlation: NO: r = 0.403; NO ₂ : r = 0.415; Oxidant: r = 0.396; SO ₂ : r = 0.675	Increment: NR Rate Ratio (Lower CI, Upper CI); lag: CO concentration <1.1 ppm: 1.00 (reference category) 1.1-1.6 ppm: 1.017 (1.009, 1.026) 1.6-2.2 ppm: 1.031 (1.020, 1.041) >2.2 ppm: 1.051 (1.039, 1.063)

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Hong et al. (2002, 035060) Period of Study: 1/1991-12/1997 Location: Seoul, Korea	Health Outcome (ICD9): Mortality: Hemorrhagic and ischemic stroke (431-434) Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.44 (0.70) ppm Range (Min, Max): (0.430, 5.14) Copollutant: TSP; SO ₂ ; NO ₂ ; O ₃	Increment: 0.76 ppm Relative Risk (Lower CI, Upper CI); lag: 1.06 (1.02, 1.09); 1 Multipollutant: CO, TSP: 1.07 (1.03, 1.11); 1 CO, NO ₂ : 1.06 (1.00, 1.11); 1 CO, SO ₂ : 1.05 (1.01, 1.10); 1 CO, O ₃ : 1.09 (1.05, 1.13); 1
Author: Hong et al. (1999, 011195) Period of Study: 1/1995-12/1995 Location: Inchon, Korea	Health Outcome (ICD9): Mortality: Cardiovascular (400-440); respiratory (460-519); nonaccidental causes (<800) Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.7 (0.8) ppm Range (Min, Max): (0.3, 5.1) Copollutant: SO ₂ ; NO ₂ ; O ₃	Increment: 1 ppm Relative Risk (Lower CI, Upper CI); lag: Total mortality: 0.993 (0.950, 1.037); 0-4 Cardiovascular mortality: 0.965 (0.892, 1.044); 0-4
Author: Hong et al. (2002, 024690) Period of Study: 1/1995-12/1998 Location: Seoul, Korea	Health Outcome (ICD9): Mortality: Stroke (160-169) Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.2 (0.5) ppm Range (Min, Max): (0.4, 3.4) Copollutant: correlation PM ₁₀ : r = 0.22; NO ₂ : r = 0.64; SO ₂ : r = 0.90; O ₃ : r = -0.35	Increment: 0.3 ppm % Increase (Lower CI, Upper CI); lag: CO: 2.2% (0.4, 4.1); 2 CO (stratified by PM ₁₀ concentration): <median concentration of PM ₁₀ : 1.1; 2 ≥ median concentration of PM ₁₀ : 3.6; 2
Author: Hong et al. (1999, 008087) Period of Study: 1/1995-8/1996 Location: Inchon, South Korea	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); respiratory; cardiovascular Study Design: Time series Statistical Analyses: Poisson GAM; LOESS Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 15.2 (7.1) ppb Range (Min, Max): (2.9, 51.2) Copollutant: PM ₁₀ ; NO ₂ ; SO ₂ ; O ₃	Increment: 100 ppb β (SE); lag: Total Mortality CO 0.0019 (0.0015); 1 0.0024 (0.0041); 0-4 CO, PM ₁₀ , NO ₂ , SO ₂ , O ₃ -0.0009 (0.0019); 1 -0.0018 (0.0043); 0-4 Cardiovascular Mortality CO 0.0019 (0.0073); 1 -0.0008 (0.0028); 0-4 CO, PM ₁₀ , NO ₂ , SO ₂ , O ₃ -0.0053 (0.0078); 1 -0.0037 (0.0033); 0-4 Respiratory Mortality CO 0.0148 (0.0065); 1 0.0063 (0.0171); 0-4 CO, PM ₁₀ , NO ₂ , SO ₂ , O ₃ 0.0121 (0.0079); 1 -0.0034 (0.0183); 0-4
Author: Keatinge et al. (2001, 017063) Period of Study: 1976-1995 Location: London, England	Health Outcome (ICD9): Mortality: Nonaccidental causes (<800) Study Design: Time series Statistical Analyses: Single- and multiple-delay regression Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant: SO ₂ ; PM ₁₀	The study did not present quantitative results for CO.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Kettunen et al. (2007, 091242) Period of Study: 1998-2004 Location: Helsinki, Finland	Health Outcome (ICD10): Mortality: Stroke (I60-I61, I63-I64) Study Design: Time series Statistical Analyses: Poisson GAM, penalized thin-plate splines Age Groups Analyzed: ≥ 65 yr	Pollutant: CO Averaging Time: Max 8-h ma Median (SD) unit: Cold Season: 0.5 mg/m ³ Warm Season: 0.4 mg/m ³ Range (Min, Max): Cold Season: (0.1, 2.4) Warm Season: (0.1, 1.1) Copollutant: correlation Cold Season: PM _{2.5} : r = 0.32; UFP: r = 0.47 Warm Season: PM _{2.5} : r = 0.24; UFP: r = 0.39	Increment: 0.2 mg/m ³ % Increase (Lower CI, Upper CI); lag: Cold Season 0.47 (-3.29 to 4.39); 0; / -0.63 (-4.39 to 3.28); 1; -2.69 (-6.46 to 1.24); 2; / -0.19 (-3.93 to 3.69); 3 Warm Season 3.95 (-3.78 to 12.30); 0; / 8.33 (0.63 to 16.63); 1; 6.97 (-0.59 to 15.11); 2; / 7.54 (-0.05 to 15.71); 3
Author: Klemm et al. (2004, 056585) Period of Study: 8/1998-7/2000 Location: Fulton County and DeKalb County, GA (ARIES)	Health Outcome (ICD9): Mortality: Nonaccidental (<800); cardiovascular (390-459); respiratory (460-519); cancer (140-239) Study Design: Time series Statistical Analyses: Poisson GLM, natural cubic splines Age Groups Analyzed: <65 yr; ≥ 65 yr	Pollutant: CO Averaging Time: 1-h max Median (SD) unit: 1,310 (939.13) ppb Range (Min, Max): (303.58, 7400) Copollutant: PM _{2.5} ; PM _{10-2.5} ; O ₃ ; NO ₂ ; SO ₂ ; Acid; EC; OC; SO ₄ ; Oxygenated HCs; NMHCs; NO ₃	Increment: NR β (SE); lag: Quarterly Knots: 0.00002 (0.00001); 0-1 Monthly Knots: 0.00002 (0.00001); 0-1 Biweekly Knots: 0.00001 (0.00002); 0-1
Author: Knox et al. (2008, 193776) Period of Study: 1996-2004 Location: 352 English local authorities	Health Outcome: Mortality Study Design: Cross sectional Statistical Analyses: Linear regression Age Groups Analyzed: NR Sample Description: Data from Oxford Cancer Intelligence Unit	Averaging Time: NR Meuan (SD) nit: NR Range (Min, Max): NR Copollutant: NR	Increment: NR <p>Significant ($p<0.01$) correlations (r) between CO and diseases: Lung cancer: 0.28, Stomach cancer: 0.20, Oesophagus cancer: -0.20, Prostate cancer: -0.25, Brain cancer: -0.24, Melanoma: -0.24, Hodgkin's: -0.19, Peripheral vascular disease: 0.15, Stroke: 0.16, Rheumatic heart disease: 0.27, Peptic ulcer: 0.28, Diabetes: 0.17, COPD: 0.25, Asthma: 0.14, Pneumonia: 0.44, Multiple sclerosis: -0.16, Motorneurone disease: -0.24, Parkinsons disease: -0.15</p> <p>Significant ($p<0.01$) socially standardized correlations between diseases and exposures: Lung cancer: 0.25, Stomach cancer: 0.18, RHD: 0.19, Pneumonia: 0.37, COPD: 0.17, Peptic ulcer: 0.16</p> <p>Lags examined: NR</p>

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Kwon et al. (2001, 016699) Period of Study: 1994-1998 Location: Seoul, Korea	Health Outcome (ICD9): Mortality: CHF (428); cardiovascular (390-459) Study Design: 1. Time-series 2. Bi-directional case-crossover Statistical Analyses: 1. Poisson GLM, LOESS 2. Conditional logistic regression Age Groups Analyzed: <55 yr 55-64 yr 65-74 yr 75-84 yr ≥ 85 yr	Pollutant: CO Averaging Time: 1-h avg Mean (SD) unit: 12.4 ppb Range (Min, Max): (4.1, 38.0) Copollutant correlation: PM ₁₀ : r = 0.713; NO ₂ : r = 0.744; SO ₂ : r = 0.843; O ₃ : r = -0.367	Increment: 0.59 ppm Odds Ratio (Lower CI, Upper CI); lag: From GAM approach CHF patients: 1.054 (0.991-1.121); 0; 0 General Population: 1.022 (1.017- 1.029); 0 From case-crossover design CHF patients: 1.033 (0.946-1.127); 0 General Population: 1.007 (0.997- .016); 0 Modifiers and CHF patients (case-crossover design) Gender Male: 1.025 (0.890-1.180); 0 Female: 1.035 (0.925-1.157); 0 Age Group: <75: 0.948 (0.890-1.180); 0 ≥ 75: 1.116 (0.989-1.258); 0 Time from admission to death 4 or less wk: 1.088 (0.907-1.306); 0 >4 wk: 1.017 (0.920-1.124); 0 Total mortality: 1.033 (0.946-1.127); 0 Cardiovascular mortality: 1.033 (0.920-1.160); 0 Cardiac death: 1.052 (0.919-1.204); 0
Author: Lee et al. (2007, 093042) Period of Study: 1/2000-12/2004 Location: Seoul, Korea	Health Outcome (ICD10): Mortality: Nonaccidental (A00-R99) Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: Max 8-h ma Mean (SD) unit: w/ Asian dust days: 0.92 (0.42) ppm w/o Asian dust days: 0.92 (0.41) ppm Asian dust days only: 1.00 (0.47) ppm Range (Min, Max): NR Copollutant: PM ₁₀ ; NO ₂ ; SO ₂ ; O ₃	Increment: 0.54 ppm % Increase (Lower CI, Upper CI); lag: Model with Asian Dust Days: 3.3% (2.5-4.1); 1 Model without Asian dust days: 3.3% (2.5-4.2); 1
Author: Lipfert et al. (2000, 004088) Period of Study: 5/1992-9/1995 Location: Philadelphia, PA, three nearby suburban Pennsylvania counties, and three nearby New Jersey counties	Health Outcome (ICD9): Mortality: Respiratory (460-519); cardiac (390-448); Cancer; other causes (<800) Study Design: Time series Statistical Analyses: Step-wise regression Age Groups Analyzed: <65 yr ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg; 1-h max Mean (SD) unit: Camden: 24-h avg: 0.75 (0.40) ppm Philadelphia: 24-h avg: 0.63 (0.40) ppm 1-h max: 1.44 (1.04) Range (Min, Max): Camden: (0.10, 3.8) Philadelphia: 24-h avg: (0.10, 3.3) 1-h max: (0.0, 7.8) Copollutant: NO; NO ₂ ; O ₃ ; SO ₂ ; SO ₄ ²⁻ ; PM ₁₀ ; PM _{2.5}	Increment: NR Attributable Risk; lag: Peak CO All-cause Philadelphia: 0.0054; 0-1 4 Pennsylvania Counties: 0.0081; 0-1 Pennsylvania + NJ: 0.0085; 0-1 CO All seven counties in Pennsylvania and New Jersey All ages Respiratory: -0.0067; Cardiac: 0.0131; Other: 0.0078 All-cause: <65: 0.0148; 0-1; ≥ 65: 0.0054; 0-1 Joint model with CO Philadelphia: 0.0059; 0-1 4 Pennsylvania Counties: 0.0089; 0-1 Pennsylvania + NJ: 0.0096; 0-1 Cardiac: 0.0135; 0-1; Other causes: 0.0084 <65: 0.0154; 0-1; ≥ 65: 0.0060; 0-1

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Lippmann et al. (2000, 011938)	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); circulatory (390-459); respiratory (460-519)	Pollutant: CO	Increment: 1985-1990: 11.5 ppm; 1992-1994: 8.4 ppm
Period of Study: 1985-1990 1992-1994	Averaging Time: 24-h avg		Relative Risk (Lower CI, Upper CI); lag:
	Study Design: Time series	Mean (SD) unit: 1985-1990: 0.9 ppm 1992-1994: 0.72 ppm	1985-1990
Location: Detroit, MI and Windsor, ON	Statistical Analyses: Poisson GLM	Range (5th, 95th): 1985-1990: (46, 1.61) 1992-1994: (0.36, 1.2)	Total Mortality: 0.9842 (0.9667-1.002); 0 1.0103 (0.9926-1.0284); 1 1.0075 (0.9898-1.0254); 2 1.0145 (0.9967-1.0326); 3 0.9968 (0.9789-1.0151); 0-1 1.0105 (0.9925-1.0288); 1-2 1.0134 (0.9954-1.0317); 2-3 1.0003 (0.9823-1.0187); 0-2 1.0152 (0.9971-1.0336); 1-3 1.0053 (0.9873-1.0236); 0-3
	Age Groups Analyzed: ≥ 65 yr	Copollutant correlation: 1985-1990 PM_{10} : r = 0.35; TSP: r = 0.28; $PM_{10-2.5}$: r = 0.02; TSP-SO ₄ ²⁻ : r = 0.18; O ₃ : r = -0.22; SO ₂ : r = 0.36; NO ₂ : r = 0.58	Circulatory Mortality: 0.9818 (0.9574-1.0068); 0 0.9991 (0.9745-1.0243); 1 0.9980 (0.9735-1.0232); 2 1.0088 (0.9841-1.0341); 3 0.9888 (0.9640-1.0144); 0-1 0.9981 (0.9732-1.0237); 1-2 1.0042 (0.9792-1.0298); 2-3 0.9900 (0.9650-1.0157); 0-2 1.0029 (0.9777-1.0287); 1-3 0.9944 (0.9692-1.0202); 0-3
		1992-1994 PM_{10} : r = 0.38; PM _{2.5} : r = 0.38; $PM_{10-2.5}$: r = 0.24; H ⁺ : r = 0.16; SO ₄ ²⁻ : r = 0.32; O ₃ : r = 0.16; SO ₂ : r = 0.42; NO ₂ : r = 0.68	Respiratory Mortality: 0.9644 (0.9042-1.0287); 0 1.0142 (0.9518-1.0808); 1 1.0483 (0.9845-1.1164); 2 1.0468 (0.9828-1.1149); 3 0.9868 (0.9248-1.053); 0-1 1.0372 (0.9730-1.1056); 1-2 1.0554 (0.9904-1.1246); 2-3 1.0088 (0.9457-1.0762); 0-2 1.0466 (0.9817-1.1158); 1-3 1.0205 (0.9569-1.0884); 0-3
			Total minus respiratory and circulatory mortality: 0.9939 (0.9668-1.0217); 0 1.0278 (1.0001-1.0562); 1 1.0178 (0.9902-1.0461); 2 1.0227 (0.9948-1.0514); 3 1.0127 (0.9860-1.0412); 0-1 1.0269 (0.9989-1.0556); 1-2 1.0249 (0.9968-1.0538); 2-3 1.0172 (0.9893-1.0458); 0-2 1.0322 (1.0041-1.0612); 1-3 1.0229 (0.9950-1.0516); 0-3
			1992-1994 Total Mortality
			0.9933 (0.9636-1.024); 0 1.0162 (0.9860-1.0473); 1 1.0116 (0.9816-1.0426); 2 0.9947 (0.9648-1.0254); 3 1.0056 (0.9756-1.0366); 0-1 1.0165 (0.9864-1.0476); 1-2 1.0038 (0.9739-1.0476); 2-3 1.0098 (0.9796-1.0409); 0-2 1.0104 (0.9862-1.0414); 1-3 1.0064 (0.9755-1.0382); 0-3
			Circulatory Mortality
			1.0076 (0.9640-1.0531); 0 1.0307 (0.9865-1.0768); 1 1.0142 (0.9705-1.0598); 2 0.9523 (0.9102-0.9964); 3 1.0229 (0.9788-1.0688); 0-1 1.0267 (0.9827-1.0727); 1-2 0.9802 (0.9375-1.0248); 2-3 1.0243 (0.9801-1.0726); 0-2 0.9987 (0.9553-1.0441); 1-3 1.0019 (0.9573-1.0487); 0-3

Study	Design	Concentrations	Effect Estimates (95% CI)
			Respiratory Mortality 0.9894 (0.8912-1.0984); 0 0.9474 (0.8521-1.0533); 1 0.9652 (0.8682-1.0732); 2 0.9931 (0.8934-1.1040); 3 0.9626 (0.8668-1.0691); 0-1 0.9485 (0.8535-1.0541); 1-2 0.9752 (0.8775-1.0838); 2-3 0.9555 (0.8802-1.0615); 0-2 0.9567 (0.8607-1.0635); 1-3 0.9584 (0.9604-1.0675); 0-3
			Total minus respiratory and circulatory mortality: 0.9769 (0.9332-1.0227); 0 1.0135 (0.9682-1.0609); 1 1.0195 (0.9747-1.0664); 2 1.0429 (0.9974-1.0905); 3 0.9940 (0.9494-1.0406); 0-1 1.0197 (0.9746-1.0670); 1-2 1.0371 (0.9918-1.0845); 2-3 1.0045 (0.9596-1.0515); 0-2 1.0353 (0.9896-1.0831); 1-3 1.0215 (0.9749-1.0702); 0-3
Author: Maheswaran et al. (2005, 090769)	Health Outcome (ICD9): Mortality: CHD (410-414)	Pollutant: CO	Increment: NR
Period of Study: 1994-1998	Study Design: Ecological	Averaging Time: 24-h avg	Rate Ratios (Lower CI, Upper CI):
Location: Sheffield, United Kingdom	Statistical Analyses: Poisson	Mean (SD) unit: NR	CO
	Age Groups Analyzed: ≥ 45 yr	Range (Min, Max): NR	Adjusted for sex and age
		Copollutant: NO _x ; PM ₁₀	Quintile: 5 (highest): 1.24 (1.14, 1.36) 4: 1.30 (1.19, 1.41) 3: 1.15 (1.05, 1.25) 2: 1.08 (0.99, 1.17) 1: (lowest): 1.00
		Notes: Quintiles represent the following mean CO concentrations and category limits: 5: 482 µg/m ³ (≥ 455) 4: 443 µg/m ³ (≥ 433 to <455) 3: 426 µg/m ³ (≥ 419 to <433) 2: 405 µg/m ³ (≥ 387 to <419) 1: 360 µg/m ³ (<387)	CO Adjusted for sex, age, deprivation, and smoking Quintile: 5 (highest): 1.05 (0.95, 1.16); 4: 1.16 (1.06, 1.28); 3: 1.04 (0.95, 1.14); 2: 1.03 (0.94, 1.13); 1 (lowest): 1.00
			CO Adjusted for sex, age, deprivation, and smoking (spatially smoothed using a 1 km radius) Quintile: 5 (highest): 1.07 (0.96, 1.18); 4: 1.13 (1.03, 1.24); 3: 1.04 (0.95, 1.14); 2: 1.01 (0.92, 1.10); 1 (lowest): 1.00

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Maheswaran et al. (2005, 088683) Period of Study: 1994-1998 Location: Sheffield, United Kingdom	Health Outcome (ICD9): Mortality: Stroke deaths (430-438) Study Design: Ecological Statistical Analyses: Poisson Age Groups Analyzed: ≥ 45 yr Range (Min, Max): NR Copollutant correlation: PM ₁₀ : r = 0.88; NO _x : r = 0.87 Notes: Quintiles represent the following mean CO concentrations and category limits: 5: 482 µg/m ³ ; 4: 443 µg/m ³ ; 3: 426 µg/m ³ ; 2: 405 µg/m ³ ; 1: 360 µg/m ³	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Quintile: 5: 482 µg/m ³ ; 4: 443 µg/m ³ ; 3: 426 µg/m ³ ; 2: 405 µg/m ³ ; 1: 360 µg/m ³ Range (Min, Max): NR Copollutant correlation: PM ₁₀ : r = 0.88; NO _x : r = 0.87 Notes: Quintiles represent the following mean CO concentrations and category limits: 5: 482 µg/m ³ (≥ 455) 4: 443 µg/m ³ (≥ 433 to <455) 3: 426 µg/m ³ (≥ 419 to <433) 2: 405 µg/m ³ (≥ 387 to <419) 1: 360 µg/m ³ (<387)	Increment: NR Rate Ratios (Lower CI, Upper CI); lag: RR for mortality and CO modeled outdoor air pollution Adjusted for sex and age Quintile: 5 (highest): 1.35 (1.19, 1.53); 4: 1.40 (1.24, 1.58); 3: 1.08 (0.95, 1.23); 2: 1.10 (0.97, 1.24); 1 (lowest): 1.00 Adjusted for sex, age, deprivation, and smoking Quintile: 5 (highest): 1.26 (1.10, 1.46); 4: 1.32 (1.15, 1.50); 3: 1.07 (0.93, 1.22); 2: 1.12 (0.99, 1.28); 1 (lowest): 1.00 Not spatially smoothed CO outdoor air pollution Quintile: 5 (highest): 1.26 (1.10, 1.46); 4: 1.32 (1.15, 1.50); 3: 1.07 (0.93, 1.22); 2: 1.12 (0.99, 1.28); 1 (lowest): 1.00 Spatially smoothed using a 1-km radius Quintile: 5 (highest): 1.16 (1.01, 1.34); 4: 1.22 (1.07, 1.39); 3: 0.95 (0.83, 1.09); 2: 0.97 (0.85, 1.11); 1 (lowest): 1.00
Author: Mar et al. (2000, 001760) Period of Study: 1995-1997 Location: Phoenix, AZ	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); cardiovascular (390-449) Study Design: Time series Statistical Analyses: Poisson Age Groups Analyzed: >65 yr Copollutant correlation: PM _{2.5} : r = 0.85; PM ₁₀ : r = 0.53; PM _{10-2.5} : r = 0.34; NO ₂ : r = 0.87; O ₃ : r = -0.40; SO ₂ : r = 0.53	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.5 (0.8) ppm Range (Min, Max): 1995: (0.5, 4.0) ppm 1996: (0.3, 4.0) ppm 1997: (0.3, 3.7) ppm Copollutant correlation: PM _{2.5} : r = 0.85; PM ₁₀ : r = 0.53; PM _{10-2.5} : r = 0.34; NO ₂ : r = 0.87; O ₃ : r = -0.40; SO ₂ : r = 0.53	Increment: 1.19 ppm Relative Risk (Lower CI, Upper CI); lag: Total Mortality (CO exposure): 1.06 (1.02, 1.09); 0; 1.05 (1.01, 1.09); 1 Cardiovascular Mortality (CO exposure): 1.05 (1.00, 1.11); 0; 1.10 (1.04, 1.15); 1; 1.07 (1.02, 1.12); 2; 1.07 (1.02, 1.12); 3; 1.08 (1.03, 1.13); 4

Study	Design	Concentrations	Effect Estimates (95% CI)
<p>Author: Moolgavkar et al. (2000, 012054)</p> <p>Period of Study: 1987-1995</p> <p>Location: Cook County, IL Los Angeles County, CA Maricopa County, AZ</p>	<p>Health Outcome (ICD9): Mortality: Circulatory (390-448); cardiovascular (390-429); cerebrovascular (430-448); COPD (490-496); asthma (493)</p> <p>Study Design: Time series</p> <p>Statistical Analyses: Poisson GAM, spline smoother</p> <p>Age Groups Analyzed: All ages</p>	<p>Pollutant: CO</p> <p>Averaging Time: 24-h avg</p> <p>Median unit: Cook county: 993 ppb Los Angeles: 1347 ppb Maricopa: 1240 ppb</p> <p>Range (Min, Max): Cook county: (224, 3912) Los Angeles: (237, 5955) Maricopa: (269, 4777)</p> <p>Copollutant correlation:</p> <p>PM₁₀: Cook: r = 0.30; LA: r = 0.45; Maricopa: r = 0.20</p> <p>NO₂: Cook: r = 0.63; LA: r = 0.80; Maricopa: r = 0.66</p> <p>SO₂: Cook: r = 0.35; LA: r = 0.78; Maricopa: r = 0.53</p> <p>O₃: Cook: r = -0.28; LA: r = -0.52; Maricopa: r = -0.61</p>	<p>Increment: 1 ppm</p> <p>% Change (Lower CI, Upper CI); lag:</p> <p>CVD Mortality Cook County CO -1.07 (-2.67, 0.54); 0; / 1.25 (-0.36, 2.87); 1; 1.49 (-0.09, 3.07); 2; / 1.90 (0.32, 3.48); 3; 1.44 (-0.16, 3.03); 4; / 0.72 (-0.89, 2.32); 5</p> <p>Los Angeles County CO 3.47 (2.94, 4.00); 0; / 3.93 (3.41, 4.46); 1; 4.08 (3.56, 4.60); 2; / 3.76 (3.24, 4.28); 3; 2.91 (2.37, 3.44); 4; / 2.63 (2.09, 3.17); 5</p> <p>CO, PM_{2.5} 2.27 (0.88, 3.66); 0; / 4.33 (2.96, 5.69); 1; 4.72 (3.38, 6.05); 2; / 4.26 (2.90, 5.63); 3; 2.49 (1.10, 3.88); 4; / 5.93 (4.60, 7.27); 5</p> <p>CO and PM_{2.5} 0.43 (-1.35, 2.20); 0; / 2.88 (1.16, 4.60); 1; 4.65 (2.93, 6.37); 2; / 5.93 (4.20, 7.65); 3; 3.88 (2.13, 5.63); 4; / 5.85 (4.12, 7.58); 5</p> <p>Maricopa County CO 0.81 (-0.79, 2.39); 0; / 2.20 (0.61, 3.79); 1; 3.05 (1.49, 4.61); 2; / 3.78 (2.27, 5.28); 3; 3.73 (2.27, 5.19); 4; / 2.25 (0.76, 3.72); 5</p> <p>COPD Mortality Cook County CO -2.65 (-7.05, 1.75); 0; / 2.80 (-1.60, 7.19); 1; 0.98 (-3.34, 5.31); 2; / 2.20 (-2.12, 6.53); 3; 1.31 (-3.06, 5.68); 4; / 1.59 (-2.78, 5.97); 5</p> <p>Los Angeles County CO 3.78 (2.31, 5.25); 0; / 5.23 (3.78, 6.69); 1; 5.71 (4.26, 7.17); 2; / 5.42 (3.95, 6.89); 3; 4.01 (2.51, 5.50); 4; / 3.82 (2.31, 5.33); 5</p> <p>Maricopa County CO 1.29 (-2.19, 4.76); 0; / 4.63 (1.17, 8.09); 1; 0.07 (-3.36, 3.50); 2; / 3.00 (-0.30, 6.30); 3; 6.21 (3.02, 9.40); 4; / 3.27 (0.04, 6.50); 5</p> <p>Cerebrovascular Disease Mortality Cook County -0.41 (-3.30, 2.47); 0; / 3.13 (0.23, 6.02); 1; 2.12 (-0.73, 4.97); 2; / 1.00 (-1.85, 3.86); 3; 2.50 (-0.36, 5.37); 4; / 1.88 (-1.00, 4.76); 5</p> <p>Los Angeles County 3.31 (2.32, 4.31); 0; / 3.88 (2.89, 4.87); 1; 3.23 (2.25, 4.22); 2; / 2.65 (1.66, 3.65); 3; 2.11 (1.11, 3.12); 4; / 2.04 (1.02, 3.06); 5</p> <p>Maricopa County 0.26 (-2.65, 3.16); 0; / 3.50 (0.60, 6.41); 1; 3.52 (0.66, 6.38); 2; / 4.61 (1.85, 7.37); 3; 4.78 (2.10, 7.46); 4; / 5.15 (2.45, 7.84); 5</p> <p>Notes: Total Mortality effect estimates were not presented quantitatively.</p>

Study	Design	Concentrations	Effect Estimates (95% CI)
<p>Author: Moolgavkar et al. (2003, 051316)</p> <p>Period of Study: 1987-1995</p> <p>Location: Cook County, Illinois & Los Angeles County, California</p>	<p>Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); circulatory (390-448)</p> <p>Study Design: Time series</p> <p>Statistical Analyses: Poisson GAM</p> <p>Age Groups Analyzed: All Ages</p>	<p>Pollutant: CO</p> <p>Averaging Time: 24-h avg</p> <p>Median unit: Cook County: 993 ppb LA County: 1347 ppb</p> <p>Range (Min, Max): Cook County: (224, 3912) ppb LA County: (237, 5955) ppb</p> <p>Copollutant correlation: Cook County: NO₂: r = 0.63; O₃: r = -0.22; SO₂: r = 0.35; PM₁₀: r = 0.30 LA County: NO₂: r = 0.80; O₃: r = -0.52; SO₂: r = 0.78; PM₁₀: r = 0.45; PM_{2.5}: r = 0.58</p>	<p>Increment: 1 ppm</p> <p>% Increase (t-statistic); lag</p> <p>Total Mortality Cook County CO: 0.6% (1.2); 0; / 2.5% (5.4); 1; / 1.2% (2.6); 2; 1.5% (3.2); 3; / 1.1% (2.5); 4; / 0.6% (1.3); 5</p> <p>CO, PM₁₀: -0.5% (-1.0); 0; / 2.2% (4.3); 1; / 1.1% (2.2); 2; 1.0% (1.9); 3; / 1.1% (2.1); 4; / 1.4% (2.7); 5</p> <p>Total Mortality Los Angeles County CO: 1.3% (7.4); 0; / 1.9% (10.5); 1; / 1.6% (8.9); 2; 1.4% (8.1); 3; / 1.0% (5.9); 4; / 0.7% (4.1); 5</p> <p>CO, PM₁₀: 0% (0); 0; / 2.2% (4.8); 1; / 1.4% (3.1); 2; 0.8% (1.8); 3; / 0.7% (1.6); 4; / 1.3% (3.0); 5</p> <p>CO, PM_{2.5}: -0.1% (-1.5); 0; / 1.5% (2.5); 1; / 2.4% (3.8); 2; 0.3% (0.5); 3; / 1.6% (2.8); 4; / 1.5% (2.6); 5</p> <p>Total Mortality (Season-specific) Cook County Spring (CO): 0.8% (0.9); 0; / 2.4% (2.9); 1; / 0% (0); 2; 1.2% (1.5); 3; / 0.8% (1.0); 4; / -0.1% (-0.2); 5</p> <p>Summer (CO): 1.2% (1.0); 0; / 3.6% (3.0); 1; / 4.2% (3.6); 2; -0.3% (-0.2); 3; / -1.1% (-1.0); 4; / -0.7% (-0.6); 5</p> <p>Fall (CO): 1.2% (1.5); 0; / 2.1% (2.7); 1; / 0% (0); 2; 0% (0); 3; / -0.5% (-0.6); 4; / -0.7% (-0.9); 5</p> <p>Winter (CO): -0.7% (-1.0); 0; / 1.8% (2.3); 1; / -0.2% (-0.3); 2; 0.5% (0.6); 3; / 1.2% (1.5); 4; / 1.0% (1.3); 5</p> <p>Los Angeles County Total Mortality (Season-specific) Spring (CO): 3.6% (6.3); 0; / 3.5% (6.2); 1; / 1.9% (3.4); 2; 0.6% (1.0); 3; / -0.5% (-0.8); 4; / -0.7% (-1.2); 5</p> <p>Summer (CO): 3.0% (3.0); 0; / 4.7% (4.6); 1; / 5.2% (5.1); 2; 4.1% (3.8); 3; / 1.9% (1.8); 4; / 1.4% (1.3); 5</p> <p>Fall (CO): 1.8% (4.6); 0; / 2.0% (5.1); 1; / 1.0% (2.6); 2; 0.6% (1.5); 3; / 0.4% (1.2); 4; / 0.2% (0.6); 5</p> <p>Winter (CO): 0% (0); 0; / 0.8% (2.5); 1; / 0.9% (3.1); 2; 1.0% (3.4); 3; / 0.5% (1.7); 4; / 0.5% (1.6); 5</p> <p>CVD Mortality Cook County CO: -1.1% (-1.5); 0; / 1.8% (2.5); 1; / 1.5% (2.2); 2; 1.6% (2.4); 3; / 1.4% (2.1); 4; / 0.7% (1.0); 5</p> <p>CO, PM₁₀: -2.1% (-2.6); 0; / 1.5% (1.8); 1; / 1.4% (1.7); 2; 0.1% (1.1); 3; / 1.4% (1.9); 4; / 1.6% (2.1); 5</p> <p>CVD Mortality Los Angeles County CO: 1.6% (6.3); 0; / 1.9% (7.6); 1; / 1.6% (6.6); 2; 1.9% (8.2); 3; / 1.6% (7.1); 4; / 1.4% (6.1); 5</p> <p>CO, PM₁₀: -0.8% (-1.2); 0; / 1.9% (3.0); 1; / 2.7% (4.3); 2; 1.3% (2.2); 3; / 0.5% (0.9); 4; / 2.8% (4.7); 5</p> <p>CO, PM_{2.5}: -2.2% (-2.7); 0; / 1.5% (1.8); 1; / 1.9% (2.0); 2; 1.9% (2.2); 3; / 2.1% (2.6); 4; / 3.7% (4.5); 5</p>

Study	Design	Concentrations	Effect Estimates (95% CI)
			CVD Mortality (Season Specific) Cook County Spring (CO): 0.7% (0.5); 0; / 1.4% (1.1); 1; / 0.3% (0.3); 2; 1.1% (0.9); 3; / 0.4% (3.1); 4; / 0.1% (0.6); 5 Summer (CO): -2.6% (-1.4); 0; / 2.5% (1.4); 1; / 6.5% (3.7); 2; 0.9% (0.5); 3; / -1.9% (-1.1); 4; / -1.0% (-0.6); 5 Fall (CO): 0% (0); 0; / 2.9% (2.5); 1; 0% (0); 2; 0% (0); 3; / -0.8% (-0.7); 4; / 0% (0); 5
			Winter (CO): -2.5% (-2.2); 0; / 0.7% (0.6); 1; / 0% (0); 2; 1.3% (1.1); 3; / 0.8% (0.7); 4; / 0.4% (0.4); 5
			Los Angeles County CVD Mortality (Season-specific) Spring (CO): 3.0% (3.7); 0; / 3.3% (4.1); 1; / 2.3% (2.9); 2; 0.7% (0.9); 3; / -1.2% (-1.6); 4; / 0% (0); 5 Summer (CO): 4.0% (2.8); 0; / 5.2% (3.5); 1; / 6.3% (4.3); 2; 5.0% (3.3); 3; / 3.1% (2.0); 4; / 3.6% (2.3); 5 Fall (CO): 2.3% (4.2); 0; / 2.1% (3.7); 1; / 1.1% (1.9); 2; 1.2% (2.2); 3; / 1.5% (2.9); 4; / 1.0% (1.8); 5 Winter (CO): 0.3% (0.8); 0; / 0.7% (1.7); 1; / 0.8% (2.0); 2; 1.4% (3.4); 3; / 1.0% (2.3); 4; / 1.1% (2.5); 5
Author: Ostro et al. (1999, 006610)	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); respiratory (460-519); cardiovascular (393-440)	Pollutant: CO	Increment: NR
Period of Study: 1989-1992	Study Design: Time series	Averaging Time: 1-h max	β (SE); lag:
Location: Coachella Valley, California	Statistical Analyses: Poisson GAM; LOESS	Mean (SD) unit: 1.35 ppm	CO: 0.0371 (0.0157); 2
	Age Groups Analyzed: >50 yr	Range (Min, Max): (0, 6.0)	CO, PM₁₀: 0.0300 (0.0194); 2
Author: Penttinen et al. (2004, 087432)	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); respiratory (460-519); cardiovascular (393-440)	Pollutant: CO	Increment: 1 mg/m ³
Period of Study: 1988-1996	Study Design: Time series	Averaging Time: Max 8-h avg	% Increase (Lower CI, Upper CI); lag:
Location: Helsinki, Finland	Statistical Analyses: Poisson GAM, LOESS	Median unit: 1.2 mg/m ³	Total Mortality -1.50% (-2.78, -0.22); 0
	Age Groups Analyzed: All ages 15-64 yr 65-74 yr ≥ 75	Range (Min, Max): (0, 12.4)	0.15% (-1.09, 1.39); 1
		Copollutant correlation: O_3 : r = -0.46; NO ₂ : r = 0.59; SO ₂ : r = 0.55; PM ₁₀ : r = 0.45; TSP: r = 0.26;	-1.00% (-2.80, 0.81); 0-3
		TSP Blackness: r = 0.26	-2.48% (-4.30, -0.66); 0
			-0.84% (-2.61, 0.93); 1
			-1.87% (-4.43, 0.69); 0-
			Respiratory Mortality -0.48% (-4.84, 3.87); 0
			-0.14% (-4.43, 4.15); 1
			-1.49% (-7.73, 4.74); 0-3
Author: Peters et al. (2000, 001756)	Health Outcome (ICD9): Mortality: Total (non-accidental) (<800); Cardiovascular (390-459); Respiratory (460-519); Cancer (140-239)	Pollutant: CO	Increment: 1 mg/m ³
Period of Study: 1982-1994	Study Design: Time-series	Averaging Time: 24-h avg	Relative Risk (Lower CI, Upper CI); lag:
Location: Northern Bavaria (Rural Germany) and the Coal Basin of the Czech Republic	Statistical Analyses: (1) Poisson Regression Models by logistic regression analyses with a cubic function; (2) Poisson GAM, natural splines	Mean (SD) unit: Coal Basin: 0.58 (0.39) mg/m ³ Northeast Bavaria: 0.88 (0.69) mg/m ³	Coal Basin of the Czech Republic Total Mortality: 1.016 (0.998, 1.035); 0; / 1.016 (0.998, 1.034); 1; 1.013 (0.996, 1.030); 2; / 1.012 (0.995, 1.028); 3
	Age Groups Analyzed: All Ages	Range (Min, Max): Coal Basin: (-0.1, 2.88) Northeast Bavaria: (0.1, 6.2)	Northeast Bavaria Total Mortality: 1.014 (0.994, 1.034); 0; / 1.023 (1.005, 1.041); 1; 1.013 (0.995, 1.031); 2; / 1.003 (0.985, 1.021); 3
		Copollutant correlation: SO ₂ : r = 0.37; TSP: r = 0.37; NO ₂ : r = 0.32; O ₃ : r = -0.57; PM ₁₀ : r = 0.44; PM _{2.5} : r = 0.42	CVD Mortality: 1.018 (0.994, 1.044); 0; / 1.012 (0.987, 1.038); 1; 1.016 (0.991, 1.041); 2; / 1.004 (0.980, 1.029); 3

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Rainham et al. (2003, 053202)	Health Outcome (ICD9): Mortality: Cardiac (390-459); Respiratory (480-519); Total (non-accidental) (<800) Period of Study: 1980-1996 Location: Toronto, ON, Canada	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.0 (0.4) ppm Range (Min, Max): (0.0, 4.0) Statistical Analyses: Poisson GAM, natural cubic splines Age Groups Analyzed: <65 ≥ 65	The study did not present quantitative results for CO.
Author: Roemer et al. (2001, 019391)	Health Outcome (ICD9): Mortality: Total (non-accidental) (<800) Period of Study: 1/1987-11/1998 Location: Amsterdam	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Air pollution background: 836 µg/m³ Air pollution traffic: 1805 µg/m³ Age Groups Analyzed: All ages Range (10th, 90th): Air pollution background: (448, 1315) µg/m³ Air pollution traffic: (727, 3192) µg/m³ Copollutant: BS; PM ₁₀ ; SO ₂ ; NO ₂ ; NO; O ₃	Increment: Lag 1 and 2: 100 µg/m³ Lag 0-6: 50 µg/m³ Relative Risk (Lower CI, Upper CI); lag: Total Population using Background sites 1.002 (1.000-1.004); 1; 1.001 (0.999-1.003); 2; 1.001 (1.000-1.003); 0-6 Traffic Population using Background Sites 1.003 (0.997-1.008); 1; 1.008 (1.003-1.013); 2; 1.003 (0.999-1.007); 0-6 Total population using Traffic Sites 1.000 (1.000-1.001); 1; 1.000 (0.999-1.001); 2; 1.000 (1.000-1.001); 0-6

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Samet et al. (2000, 013132) Period of Study: 1987-1994 Location: 20 U.S. Cities: Los Angeles, CA; New York, NY; Chicago, IL; Dallas, TX; Houston, TX; San Diego, CA; Anaheim, CA; Phoenix, AZ; Detroit, MI; Miami, FL; Philadelphia, PA; Minneapolis, MN; Seattle, WA; San Jose, CA; Cleveland, OH; San Bernardino, CA; Pittsburgh, PA; Oakland, CA; Atlanta, GA; San Antonio, TX	Health Outcome (ICD9): Mortality: Cardiovascular (390-459); Respiratory (460-519); Other (non-accidental) (<800) Study Design: Time-series Statistical Analyses: Two-stage log linear regression model Age Groups Analyzed: <65 65-74 ≥ 75	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: Los Angeles: 15.1 ppm New York: 20.4 ppm Chicago: 7.9 ppm Dallas: 7.4 ppm Houston: 8.9 ppm San Diego: 11.0 ppm Anaheim: 12.3 ppm Phoenix: 12.6 ppm Detroit: 6.6 ppm Miami: 10.6 ppm Philadelphia: 11.8 ppm Minneapolis: 11.8 ppm Seattle: 17.8 ppm San Jose: 9.4 ppm Cleveland: 8.5 ppm San Bernardino: 10.3 ppm Pittsburgh: 12.2 ppm Oakland: 9.1 ppm Atlanta: 8.0 ppm San Antonio: 10.1 ppm Range (10th, 90th): Los Angeles: (5.9, 28.3) New York: (14.8, 27.6) Chicago: (4.5, 11.9) Dallas: (3.6, 12.0) Houston: (4.0, 14.2) San Diego: (4.5, 20.5) Anaheim: (3.7, 25.2) Phoenix: (5.4, 22.6) Detroit: (3.2, 11.1) Miami: (6.5, 15.9) Philadelphia: (7.0, 17.2) Minneapolis: (7.0, 17.0) Seattle: (10.5, 26.4) San Jose: (1.7, 21.3) Cleveland: (3.7, 13.8) San Bernardino: (4.0, 17.5) Pittsburgh: (6.1, 19.8) Oakland: (2.9, 17.0) Atlanta: (3.2, 14.3) San Antonio: (4.1, 17.3)	This study did not provide quantitative results for CO.
Author: Samoli et al. (2007, 098420) Period of Study: 1990-1997 Location: 19 European Cities (APHEA2)	Health Outcome (ICD9): Mortality: Total (non-accidental) (<800); Cardiovascular (390-459) Study Design: Time-series Statistical Analyses: Poisson and two-stage hierarchical model Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean Range (unit-mg/m³): Athens: 6.1; Barcelona: 0.9; Basel: 0.6; Birmingham: 1.0; Budapest: 5.1; Geneva: 1.5; Helsinki: 1.2; Ljubljana: 1.6; London: 1.4; Lyon: 3.8; Milano: 5.4; Netherlands: 0.6; Prague: 0.9; Rome: 4.1; Stockholm: 0.8; Teplice: 0.7; Torino: 5.5; Valencia: 4.1; Zurich: 1.2 Range (10th, 90th): Athens: (3.5, 9.2) Barcelona: (0.4, 1.7) Basel: (0.4, 1.1) Birmingham: (0.5, 1.6) Budapest: (3.3, 7.4) Geneve: (0.8, 2.6) Helsinki: (0.7, 1.9) Ljubljana: (0.6, 3.0) London: (0.7, 2.2) Lyon: (2.0, 6.0) Milano: (2.9, 8.7) Netherlands: (0.4, 1.2) Prague: (0.5, 1.5)	Increment: 1 mg/m³ % Increase (Lower CI, Upper CI); lag: Non-accidental mortality 8 Degrees of Freedom per yr Fixed Effects: CO: 0.59% (0.41-0.78); 0-1 CO, BS: 0.35% (-0.03 to 0.72); 0-1 CO, PM ₁₀ : 0.48% (0.24-0.72); 0-1 CO, SO ₂ : 0.44% (0.21-0.67); 0-1 CO, O ₃ : 0.66% (0.46-0.86); 0-1 CO, NO ₂ : 0.27% (0.03-0.51); 0-1 Random Effects: CO: 0.66% (0.27-1.05); 0-1 CO, BS: 0.45% (-0.01 to 0.92); 0-1 CO, PM ₁₀ : 0.58% (0.12-1.04); 0-1 CO, SO ₂ : 0.46% (0.07-0.85); 0-1 CO, O ₃ : 0.76% (0.45-1.06); 0-1 CO, NO ₂ : 0.30% (-0.11 to 0.71); 0-1 PACF: (Partial Autocorrelation Function) Plot Fixed Effects: CO: 1.00% (0.83-1.18); 0-1 CO, BS: 0.67% (0.30-1.04); 0-1 CO, PM ₁₀ : 0.78% (0.55-1.00); 0-1 CO, SO ₂ : 0.68% (0.47-0.90); 0-1 CO, O ₃ : 1.12% (0.93-1.31); 0-1 CO, NO ₂ : 0.72% (0.50-0.95); 0-1

Study	Design	Concentrations	Effect Estimates (95% CI)
		<p>Rome: (2.5, 5.9) Stockholm: (0.5, 1.2) Teplice: (0.3, 1.2) Torino: (2.8, 9.1) Valencia: (2.4, 5.9) Zurich: (0.7, 2.0)</p> <p>Copollutant correlation: PM_{10}: $r = 0.16$ to 0.70 BS: $r = 0.67$ to 0.82 SO_2: $r = 0.35$ to 0.82 NO_2: $r = 0.03$ to 0.68 O_3: $r = -0.25$ to -0.65</p>	<p>Random Effects: CO: 1.20% (0.63-1.77); 0-1 CO, BS: 0.77% (0.28-1.26); 0-1 CO, PM_{10}: 1.09% (0.36-1.83); 0-1 CO, SO_2: 0.75% (0.26-1.26); 0-1 CO, O_3: 1.37% (0.81-1.95); 0-1 CO, NO_2: 0.88% (0.22-1.55); 0-1 Cardiovascular Mortality 8 Degrees of Freedom per Year Fixed Effects: CO: 0.80% (0.53-1.07); 0-1 CO, BS: 0.49% (-0.04 to 1.02); 0-1 CO, PM_{10}: 0.73% (0.39-1.07); 0-1 CO, SO_2: 0.72% (0.39-1.04); 0-1 CO, O_3: 0.91% (0.62-1.20); 0-1 CO, NO_2: 0.44% (0.10-0.79); 0-1 Random Effects: CO: 0.81% (0.36-1.26); 0-1 CO, BS: 0.49% (-0.04 to 1.02); 0-1 CO, PM_{10}: 0.73% (0.39-1.07); 0-1 CO, SO_2: 0.68% (-0.03 to 1.40); 0-1 CO, O_3: 1.02% (0.58-1.46); 0-1 CO, NO_2: 0.43% (-0.06 to 0.93); 0-1 PACF (Partial Autocorrelation Function) Fixed Effects: CO: 1.06% (0.80-1.32); 0-1 CO, BS: 0.83% (0.31-1.35); 0-1 CO, PM_{10}: 0.95% (0.62-1.27); 0-1 CO, SO_2: 0.91% (0.59-1.22); 0-1 CO, O_3: 1.28% (1.01-1.56); 0-1 CO, NO_2: 0.68% (0.35-1.00); 0-1 Random Effects: CO: 1.25% (0.30-2.21); 0-1 CO, BS: 0.83% (0.31-1.35); 0-1 CO, PM_{10}: 1.13% (0.60-1.67); 0-1 CO, SO_2: 0.86% (0.06-1.66); 0-1 CO, O_3: 1.62% (0.72-2.52); 0-1 CO, NO_2: 0.84% (-0.03 to 1.71); 0-1 Effect Modifiers Non-accidental Mortality 8 Degrees of Freedom per Year Number of CO monitors: 25th Percentile: 0.71% (0.48-0.94); 0-1 75th Percentile: 0.54% (0.34-0.74); 0-1 Mean PM_{10} Levels: 25th Percentile: 0.37% (0.08-0.66); 0-1 75th Percentile: 0.49% (0.28-0.69); 0-1 Standardized Mortality Rate: 25th Percentile: 0.79% (0.55-1.03); 0-1 75th Percentile: 0.44% (0.22-0.66); 0-1 Western cities: 0.75% (0.47-1.03); 0-1 Southern cities: 0.61% (0.32-0.91); 0-1 Eastern cities: 0.03% (-0.47 to 0.53); 0-1 PACF (Partial Autocorrelation Function) Number of CO monitors: 25th Percentile: 1.18% (0.96-1.39); 0-1 75th Percentile: 0.92% (0.73-1.11); 0-1 Mean PM_{10} Levels: 25th Percentile: 0.74% (0.46-1.02); 0-1 75th Percentile: 1.07% (0.87-1.27); 0-1 Standardized Mortality Rate: 25th Percentile: 1.29% (1.06-1.52); 0-1 75th Percentile: 0.77% (0.56-0.98); 0-1 Western cities: 1.15% (0.90-1.40); 0-1 Southern cities: 1.08% (0.79-1.38); 0-1 Eastern cities: 0.27% (-0.20 to 0.74); 0-1 Cardiovascular Mortality 8 Degrees of Freedom per Year Mean O_3: 25th Percentile: 1.04% (0.67-1.41); 0-1 75th Percentile: 0.82% (0.55-1.10); 0-1 Standardized Mortality Rate: 25th Percentile: 1.06% (0.71-1.42); 0-1 75th Percentile: 0.61% (0.30-0.93); 0-1</p>

Study	Design	Concentrations	Effect Estimates (95% CI)
			Population >75 yr of age (%): 25th Percentile: 0.58% (0.25-0.92); 0-1 75th Percentile: 0.94% (0.64-1.24); 0-1 Western cities: 1.06% (0.67-1.46); 0-1 Southern cities: 0.70% (0.26-1.14); 0-1 Eastern cities: 0.21% (-0.48 to 0.90); 0-1 PACF (Partial Autocorrelation Function) Mean O ₃ : 25th Percentile: 1.32% (0.96-1.68); 0-1 75th Percentile: 1.09% (0.83-1.14); 0-1 Standardized Mortality Rate: 25th Percentile: 1.40% (1.06-1.75); 0-1 75th Percentile: 0.85% (0.55-1.14); 0-1 Population >75 yr of age (%): 25th Percentile: 0.74% (0.41-1.06); 0-1 75th Percentile: 1.25% (0.96-1.54); 0-1 Western cities: 1.38% (1.00-1.76); 0-1 Southern cities: 0.90% (0.47-1.33); 0-1 Eastern cities: 0.48% (-0.14 to 1.11); 0-1
Author: Schwartz et al. (1999, 017915)	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800)	Pollutant: CO	The study did not present quantitative results for CO.
Period of Study: 1989-1995	Study Design: Time series	Averaging Time: 1-h avg	
Location: Spokane, WA	Statistical Analyses: Poisson GAM	Mean (SD) unit: Dust Storm Days: 09/08/1990: 6.37 ppm 09/12/1990: 3.40 ppm 10/04/1990: 3.15 ppm	
	Age Groups Analyzed: All ages	11/09/1990: 2.45 ppm 11/23/1990: 2.50 ppm 09/13/1991: 4.60 ppm 10/16/1991: 2.10 ppm 10/21/1991: 2.20 ppm 09/04/1992: 3.43 ppm 09/12/1992: 1.80 ppm 09/13/1992: 1.65 ppm 09/25/1992: 2.95 ppm 09/26/1992: 4.30 ppm 10/08/1992: 3.85 ppm 09/11/1993: 1.88 ppm 11/3/1993: 5.33 ppm 07/24/1994: 2.10 ppm 08/30/1996: 2.85 ppm	
		Range (Min, Max): NR	
		Copollutant: PM ₁₀	
Author: Sharovsky et al. (2004, 156976)	Health Outcome (ICD10): Mortality: MI (I.21)	Pollutant: CO	Increment: NR
Period of Study: 1996-1998	Study Design: Time series	Averaging Time: 24-h avg	β x 100 (SE); lag:
Location: Sao Paulo, Brazil	Statistical Analyses: Poisson GAM, LOESS	Mean (SD) unit: 3.7 (1.6) ppm	CO: 1.42 (1.01) CO, SO ₂ , PM ₁₀ : 0.97 (1.27)
	Age Groups Analyzed: 35-109 yr	Range (Min, Max): (1.0, 11.8)	Notes: The study did not present the lag used for CO.
		Copollutant: correlation SO ₂ : r = 0.73; PM ₁₀ : r = 0.51	
Author: Slaughter et al. (2005, 073854)	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); respiratory (460-519); asthma (493); COPD (491, 492, 494, 496); pneumonia (480-487); acute upper respiratory tract infections (464-466, 490); cardiac outcomes (390-459)	Pollutant: CO	The study did not present quantitative results for CO.
Period of Study: 1/1995-6/2001	Study Design: Time series	Averaging Time: 24-h avg	
Location: Spokane, WA	Statistical Analyses: Log-linear Poisson GLM, natural splines for calendar time	Mean (SD) unit: Areas in Spokane Hamilton St: 1.73 (0.46) ppm Backdoor Tavern: 1.29 (0.23) ppm Spokane Club: 1.41 (0.32) ppm Third and Washington: 1.82 (0.33) ppm Rockwood: 0.42 (0.15) ppm	
	Age Groups Analyzed: All ages	Range (Min, Max): NR	
		Copollutant correlation: PM ₁ : r = 0.63; PM _{2.5} : r = 0.62; PM ₁₀ : r = 0.32; PM _{10-2.5} : r = 0.32	

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Stieb et al. (2003, 056908) Period of Study: 1985-2000 Location: All locations	Health Outcome (ICD9): Mortality: Nonaccidental Study Design: Meta-analysis Statistical Analyses: NR Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: NR IQR (25th, 75th): NR Copollutant: NR	Increment: 1.1 ppm % Excess Mortality (Lower CI, Upper CI); lag: Non-GAM: Single-pollutant model (4 studies): 4.7% (1.1-8.4) Multi-pollutant model (1 study): 0.0% (-3.8 to 3.8) GAM: Single-pollutant model (18 studies): 1.6% (1.1-2.1) Multi-pollutant model (11 studies): 0.7% (-0.1 to 1.5)
Author: Stölzel et al. (2007, 091374) Period of Study: 9/1995-8/2001 Location: Erfurt, Germany	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); cardio-respiratory (390-459, 460-519, 785, 786) Study Design: Time series Statistical Analyses: Poisson GAM Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.47 (0.39) mg/m ³ IQR (25th, 75th): (0.23, 0.57) Copollutant correlation: MC0.1-0.5: r = 0.58; MC0.01-2.5: r = 0.57; PM ₁₀ : r = 0.50; NO: r = 0.70; NO ₂ : r = 0.71	Increment: 0.34 mg/m ³ Relative Risk (Lower CI, Upper CI); lag: Total (non-accidental): 1.000 (0.977-1.023); 0; 1.002 (0.980-1.024); 1; 1.013 (0.991-1.035); 2; 1.007 (0.986-1.029); 3; 1.012 (0.990-1.034); 4; 0.995 (0.974-1.017); 5
Author: Sunyer et al. (2001, 019367) Period of Study: 1990-1995 Location: Barcelona, Spain	Health Outcome (ICD9): Mortality: COPD (491, 492, 494, 496) Study Design: Bidirectional case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: >35 yr	Pollutant: CO Averaging Time: 8-h avg Mean (SD) unit: NR Range (Min, Max): NR Copollutant: PM ₁₀ ; NO ₂ ; O ₃	Increment: 4.5 µg/m ³ Odds Ratio (Lower CI, Upper CI); lag: CO: 1.052 (0.990-1.117); 0-2 CO, PM ₁₀ : 1.017 (0.947-1.091); 0-2
Author: Sunyer et al. (2002, 034835) Period of Study: 1985-1995 Location: Barcelona, Spain	Health Outcome (ICD9): Mortality: Respiratory mortality Study Design: Case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: >14 yr Study population: Asthmatic individuals: 5,610	Pollutant: CO Averaging Time: 24-h avg Median (SD) unit: 7.7 µg/m ³ Range (Min, Max): (0.6, 66.0) Copollutant: PM ₁₀ ; BS; NO ₂ ; O ₃ ; SO ₂	Increment: 7.2 µg/m ³ Odds Ratio (Lower CI, Upper CI); lag: Asthmatic individuals with 1 ED visit 1.127 (0.895-1.418); 0-2 Asthmatic individuals with >1 ED visit 1.125 (0.773-1.638); 0-2 Asthma/COPD individuals with >1 ED visit 0.815 (0.614-1.082); 0-2
Author: Tsai et al. (2003, 050480) Period of Study: 1994-2000 Location: Kaohsiung, Taiwan	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); respiratory (460-519); circulatory (390-459) Study Design: Bidirectional case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.827 ppm Range (Min, Max): (0.226, 1.770) Copollutant: PM ₁₀ ; SO ₂ ; NO ₂ ; O ₃	Increment: 0.313 ppm Odds Ratio (Lower CI, Upper CI); lag: Total (nonaccidental): 1.003 (0.968-1.039); 0-2 Respiratory: 1.011 (0.883-1.159); 0-2 Circulatory: 0.986 (0.914-1.063); 0-2
Author: Tsai et al. (2006, 090709) Period of Study: 1994-2000 Location: Kaohsiung, Taiwan	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800) Study Design: Case crossover Statistical Analyses: Conditional logistic regression Age Groups Analyzed: 27 days old to <1 yr of age	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 8.27 ppm Range (Min, Max): (2.26, 17.70) Copollutant: PM ₁₀ ; SO ₂ ; O ₃ ; NO ₂	Increment: 0.31 ppm Odds Ratio (Lower CI, Upper CI); lag: Postneonatal Mortality 1.051 (0.304-3.630); 0-2

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Vedral et al. (2003, 039044) Period of Study: 1/1994-12/1996 Location: Vancouver, BC, Canada	Health Outcome (ICD9): Mortality: Total (nonaccidental) (<800); respiratory (460-519); cardiovascular (390-459) Study Design: Time series Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: All ages	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.6 (0.2) ppm Range (Min, Max): (0.3, 1.9) Copollutant correlation: Summer: $PM_{10}; r = 0.71$; $O_3; r = 0.12$; $NO_2; r = 0.81$; $SO_2; r = 0.67$ Winter: $PM_{10}; r = 0.76$; $O_3; r = -0.65$; $NO_2; r = 0.78$; $SO_2; r = 0.83$	The study did not present quantitative results for CO.
Author: Villeneuve et al. (2003, 055051) Period of Study: 1986-1999 Location: Vancouver, BC, Canada	Health Outcome (ICD9): Mortality: Nonaccidental (<800); cardiovascular (401-440); respiratory (460-519); cancer (140-239) Study Design: Time series Statistical Analyses: Poisson, natural splines Age Groups Analyzed: ≥ 65 yr	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.0 ppm Range (Min, Max): (0.2, 4.9) Copollutant: $PM_{2.5}$; PM_{10} ; $PM_{10-2.5}$; TSP; SO_4 ; CO; COH; O_3 ; NO_2 ; SO_2	Increment: 1.1 ppb % Increase (Lower CI, Upper CI); lag: Non-accidental $0.5\% (-1.9 \text{ to } 2.9); 0-2$; / $-0.3\% (-2.2 \text{ to } 1.7); 0$; $0.6\% (-1.3 \text{ to } 2.6); 1$; / $0.5\% (-1.4 \text{ to } 2.5); 2$ Cardiovascular $2.3\% (-1.6 \text{ to } 6.3); 0-2$; / $1.6\% (-1.5 \text{ to } 4.7); 0$; $1.2\% (-2.0 \text{ to } 4.5); 1$; / $1.5\% (-1.5 \text{ to } 4.4); 2$ Respiratory $-1.0\% (-7.3 \text{ to } 5.8); 0-2$; / $1.3\% (-4.4 \text{ to } 7.3); 0$; $-0.1\% (-5.3 \text{ to } 5.4); 1$; / $2.8\% (-7.8 \text{ to } 2.6); 2$ Cancer $-2.8\% (-7.6 \text{ to } 2.4); 0-2$; / $-3.0\% (-6.9 \text{ to } 1.1); 0$; $-1.6\% (-5.6 \text{ to } 2.4); 1$; / $-0.5\% (-4.7 \text{ to } 3.8); 2$
Author: Wang et al. (2008, 179974) Period of Study: Daily CO content: 2000-2005 (data from Beijing Environment Protection Bureau), Death rate: 2000-2003 Location: Beijing, China	Health Outcome: Mortality Study Design: Time series, Granger causality, Back propagation neural network model, MIV Statistical Analyses: Eviews 3.1, SAS 9.0, Matlab 7.0 Age Groups Analyzed: NR Sample Description: Death rate of respiratory diseases in Beijing from China Centers for Disease Control and Prevention	Averaging Time: NR Mean (SD) unit: NR Range (Min, Max): NR Copollutant: NR	Increment: NR Granger causality: Acute respiratory diseases probability: 0.03122 COPD probability: 0.00047 Change of death rate of acute respiratory diseases: Increasing 10%: +0.437, Decreasing 10%: -0.386 Change of death rate of COPD: Increasing 10%: +0.181, Decreasing 10%: -0.316 Lags examined: 10

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Wichmann et al. (2000, 013912)	Health Outcome (ICD9): Mortality: Nonaccidental (<800); cardiovascular (401-440); respiratory (460-519)	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 0.6 (0.5) mg/m ³ Range (Min, Max): (0.10, 2.50)	Increment: 0.5 ppm Relative Risk (Lower CI, Upper CI); lag: Single-Day Lag CO: 1.055 (1.003-1.110); 4 Polynomial Distributed Lag Multi-pollutant model: 1.076 (1.017-1.138); 4
Period of Study: 9/1995-12/1998	Study Design: Time series	Copollutant: correlation PM _{2.5} : r = 0.62; PM ₁₀ : r = 0.58; TSP: r = 0.57; SO ₂ : r = 0.59; NO ₂ : r = 0.71	Total Mortality CO: 1.012 (0.977-1.049); 0 Log-transformed: 1.016 (0.962-1.073); 0 1.004 (0.969-1.040); 1 Log-transformed: 1.027 (0.973-1.083); 1 1.020 (0.984-1.057); 2 Log-transformed: 1.024 (0.970-1.081); 2 1.019 (0.984-1.055); 3 Log-transformed: 1.037 (0.984-1.093); 3 1.029 (0.995-1.063); 4 Log-transformed: 1.055 (1.003-1.110); 4 0.997 (0.965-1.031); 5 Log-transformed: 1.014 (0.966-1.065); 5
Location: Erfurt, Germany	Statistical Analyses: Poisson GAM, LOESS Age Groups Analyzed: <70 70-79 ≥ 80		Total Mortality (Season-specific): Log-transformed Winter: 1.002 (0.922-1.088); 4 Spring: 1.019 (0.942-1.102); 4 Summer: 1.085 (1.018-1.156); 4 Fall: 1.111 (1.039-1.188); 4 Winter-specific: Log-transformed 10/95-3/96: 1.046 (0.949-1.153); 4 10/96-3/97: 1.091 (0.998-1.193); 4 10/97-3/98: 1.028 (0.966-1.095); 4 One-pollutant Model: Log-transformed CO: 1.055 (1.003-1.110); 4
Author: Yang et al. (2004, 055603)	Health Outcome (ICD9): Mortality: Nonaccidental (<800); circulatory (390-459); respiratory (460-519)	Pollutant: CO Averaging Time: 24-h avg Mean (SD) unit: 1.16 ppm Range (Min, Max): (0.24, 4.42)	Increment: 0.52 ppm Odds Ratio (Lower CI, Upper CI); lag: Non-accidental: 1.005 (0.980-1.031); 0-2
Period of Study: 1994-1998	Study Design: Bidirectional case crossover	Copollutant: PM ₁₀ ; SO ₂ ; NO ₂ ; O ₃	Respiratory: 1.014 (0.925-1.110); 0-2
Location: Taipei, Taiwan	Statistical Analyses: Conditional logistic regression Age Groups Analyzed: All ages		Circulatory: 0.996 (0.948-1.046); 0-2

Table C-8. Studies of long-term CO exposure and mortality.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Krewski et al. (2009, 191193) Period of Study: 1983-2000 Location: United States	Health Outcome: Mortality Study Design: Cohort Statistical Analyses: Random effects Cox model Age Groups Analyzed: 30+ yrs Sample Description: 508,538 adults living in large US cities	Averaging Time: 1980 annual avg Mean (SD) unit: 1.68 (0.66) ppm Range (min, max): 0.19, 3.95 Copollutant: PM ₁₅ , PM _{2.5} , SO ₂ , SO ₄ , TSP, O ₃ , NO ₂	Increment: 1ppm HR Estimate [Lower CI, Upper CI]: Lags examined: NR All Causes: 1.00 (0.99, 1.01) Cardiopulmonary: 1.00 (0.99, 1.01) IHD: 1.01 (0.99, 1.03) Lung Cancer: 0.99 (0.97, 1.03) All Other Causes: 0.99 (0.98, 1.01)
Author: Lipfert et al. (2000, 004087) Period of Study: 1975-1996 Location: 32 Veterans Hospitals, USA	Mortality Health Outcome (ICD9): Nonaccidental Study Design: Cohort Study Population: ~90,000 hypertensive male U.S. veterans Statistical Analyses: Staged regression Age Groups Analyzed: NR	Pollutant: CO Averaging Time: 95th Percentile Annual avg Mean (SD) unit: 1960-1974: 10.82 (5.15) ppm 1975-1981: 7.64 (2.94) ppm 1982-1988: 3.42 (0.95) ppm 1989-1996: 2.36 (0.67) ppm Range (Min, Max): 1960-1974: (0.94, 35.30) 1975-1981: (0.43, 22.38) 1982-1988: (0.30, 15.20) 1989-1996: (0.30, 7.10) Copollutants; correlation: 1960-1974: O ₃ : r = 0.004; NO ₂ : r = 0.690; SO ₄ : r = 0.469 1975-1981: O ₃ : r = 0.109; NO ₂ : r = 0.249; SO ₄ : r = -0.155; IP SO ₄ : r = 0.356; PM _{2.5} : r = 0.634; PM _{10-2.5} : r = 0.498; PM ₁₅ : r = 0.626 1982-1988 O ₃ : r = 0.158; NO ₂ : r = 0.413; SO ₄ : r = -0.518; IP SO ₄ : r = 0.075; PM _{2.5} : r = 0.296; PM _{10-2.5} : r = 0.135 PM ₁₅ : r = 0.284 1989-1996 O ₃ : r = 0.397; NO ₂ : r = 0.492; SO ₄ : r = -0.551	Increment: NR Coefficient: Baseline Model Exposure Period: up to 1975 Single Period: -0.000 Deaths, 1976-81: 0.0043 Deaths, 1982-88: -0.0002 Deaths after 1988: -0.0041 Exposure Period: 1975-81 Single Period: -0.013 Deaths, 1976-81: -0.0170 Deaths, 1982-88: -0.0217 Deaths after 1988: -0.0240 Exposure Period: 1982-88 Single Period: -0.028 Deaths, 1976-81: -0.0294 Deaths, 1982-88: -0.0484 Deaths after 1988: -0.0424 Exposure Period: 1989-96 Single Period: -0.046 Deaths, 1976-81: -0.0590 Deaths, 1982-88: -0.0581 Deaths after 1988: -0.0536 Final Model w/ Ecological Variables Exposure Period: up to 1975 Single Period: -0.001 Deaths, 1976-81: 0.0013 Deaths, 1982-88: -0.0022 Deaths after 1988: -0.0061 Exposure Period: 1975-81 Single Period: -0.008 Deaths, 1976-81: -0.0128 Deaths, 1982-88: -0.0186 Deaths after 1988: -0.0203 Exposure Period: 1982-88 Single Period: -0.009 Deaths, 1976-81: -0.0007 Deaths, 1982-88: -0.0246 Deaths after 1988: -0.0216 Exposure Period: 1989-96 Single Period: -0.009 Deaths, 1976-81: -0.0106 Deaths, 1982-88: -0.0136 Deaths after 1988: -0.0078
			Notes: Mortality risks based on mean concentrations of pollutants less estimated background weighted by the number of subjects in each county, but the study did not present this value for each pollutant.

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Lipfert and Morris (2002, 019217)	Mortality	Pollutant: CO	Increment: NR
Period of Study: 1960-1997	Health Outcome (ICD9): Nonaccidental	Averaging Time: Annual avg	Attributable risk (SE):
Location: U.S. counties	Study Design: Ecological/ cross sectional	Mean (SD) unit: 1960-1969: 13.81 (8.47) ppm 1970-1974: 9.64 (5.63) ppm 1979-1981: 5.90 (3.54) ppm	Attributable Risks of mortality (1960-4) Peak CO 1960-1964, All locations Ages 15-44: 0.1299 (0.0341) Ages 45-64: 0.0340 (0.0280) Ages 65-74: -0.0058 (0.0220) Ages 75-84: 0.0121 (0.0188) Ages ≥ 85: 0.0374 (0.0225) Log Mean: 0.0365 (0.0149)
	Statistical Analyses: Staged regression	1989-1991: 2.69 (1.22) ppm 1995-1997: 1.72 (0.76) ppm	
	Age Groups Analyzed: 15-44 yr 45-64 yr 65-74 yr 75-84 yr ≥ 85 yr	Range (Min, Max): NR	
		Copollutant: TSP SO_4^{2-} SO_2 NO_2 O_3	Attributable Risks of mortality (1970-4) Peak CO 1970-1974, All locations Ages 15-44: 0.0553 (0.0240) Ages 45-64: 0.0181 (0.0148) Ages 65-74: -0.0146 (0.0134) Ages 75-84: -0.0128 (0.0098) Ages ≥ 85: -0.0151 (0.0093) Log Mean: 0.0038 (0.0086)
			Attributable Risks of mortality (1979-81) Peak CO 1979-1981, All locations Ages 15-44: 0.0054 (0.0174) Ages 45-64: -0.0060 (0.0141) Ages 65-74: -0.0251 (0.0105) Ages 75-84: -0.0331 (0.0086) Ages ≥ 85: -0.0123 (0.0079) Log Mean: -0.0183 (0.0077)
			Peak CO 1970-1974, All locations Ages 15-44: 0.0218 (0.0200) Ages 45-64: 0.0327 (0.0161) Ages 65-74: -0.0136 (0.0119) Ages 75-84: -0.0250 (0.0105) Ages ≥ 85: -0.0202 (0.0085) Log Mean: -0.0048 (0.0077)
			Peak CO 1960-1969, All locations Ages 15-44: 0.0506 (0.0478) Ages 45-64: 0.0704 (0.0337) Ages 65-74: 0.0100 (0.0211) Ages 75-84: -0.0124 (0.0143) Ages ≥ 85: 0.0187 (0.0135) Log Mean: 0.0084 (0.0149)
			Peak CO 1979-1981, CO 1970-1974 Ages 15-44: 0.0244 (0.0209) Ages 45-64: 0.0016 (0.0181) Ages 65-74: -0.0183 (0.0128) Ages 75-84: -0.0382 (0.0108) Ages ≥ 85: -0.0201 (0.0089) Log Mean: -0.0165 (0.0089)
			Peak CO 1979-1981, CO 1960-1969 Ages 15-44: 0.0748 (0.0679) Ages 45-64: 0.0844 (0.0496) Ages 65-74: 0.0144 (0.0259) Ages 75-84: -0.0158 (0.0168) Ages ≥ 85: -0.0073 (0.0170) Log Mean: 0.0109 (0.0218)
			Peak CO 1979-1981, CO 1960-1969 Ages 15-44: 0.1191 (0.0709) Ages 45-64: 0.1163 (0.0491) Ages 65-74: 0.0177 (0.0310) Ages 75-84: -0.0120 (0.0212) Ages ≥ 85: -0.0040 (0.0202) Log Mean: 0.0211 (0.0231)
			Attributable Risks of mortality (1989-91) Peak CO 1989-1991, All locations Ages 15-44: 0.0404 (0.0322) Ages 45-64: -0.0262 (0.0162) Ages 65-74: -0.0397 (0.0115) Ages 75-84: -0.0464 (0.0097) Ages ≥ 85: -0.0209 (0.0073) Log Mean: -0.0178 (0.0098)
			Peak CO 1979-1981, All locations

Study	Design	Concentrations	Effect Estimates (95% CI)
		Ages 15-44: 0.0522 (0.0227) Ages 45-64: -0.0047 (0.0121) Ages 65-74: -0.0165 (0.0078) Ages 75-84: -0.0268 (0.0068) Ages ≥ 85: -0.0027 (0.0055) Log Mean: -0.0020 (0.0065)	
		Peak CO 1970-1974, All locations Ages 15-44: 0.0685 (0.0274) Ages 45-64: 0.0022 (0.0148) Ages 65-74: -0.0051 (0.0091) Ages 75-84: -0.0158 (0.0079) Ages ≥ 85: -0.0069 (0.0060) Log Mean: 0.0038 (0.0077)	
		Peak CO 1960-1969, All locations Ages 15-44: 0.0578 (0.0713) Ages 45-64: 0.0583 (0.0347) Ages 65-74: 0.0007 (0.0174) Ages 75-84: -0.0245 (0.0130) Ages ≥ 85: -0.0138 (0.0113) Log Mean: 0.0041 (0.0176)	
		Attributable Risks of mortality (1995-97) Peak CO 1995-1997, All locations Ages 15-44: 0.0344 (0.0256) Ages 45-64: -0.0203 (0.0198) Ages 65-74: -0.0346 (0.0146) Ages 75-84: -0.0378 (0.0161) Ages ≥ 85: -0.0283 (0.0119) Log Mean: -0.0188 (0.0103)	
		Peak CO 1989-1991, All locations Ages 15-44: 0.0289 (0.0248) Ages 45-64: -0.0192 (0.0192) Ages 65-74: -0.0466 (0.0140) Ages 75-84: -0.0497 (0.0147) Ages ≥ 85: -0.0301 (0.0108) Log Mean: -0.0240 (0.0096)	
		Peak CO 1979-1981, All locations Ages 15-44: 0.0336 (0.0176) Ages 45-64: -0.0037 (0.0135) Ages 65-74: -0.0298 (0.0096) Ages 75-84: -0.0301 (0.0105) Ages ≥ 85: -0.0087 (0.0078) Log Mean: -0.0094 (0.0071)	
		Peak CO 1970-1974, All locations Ages 15-44: 0.0464 (0.0202) Ages 45-64: 0.0202 (0.0155) Ages 65-74: -0.0032 (0.0112) Ages 75-84: -0.0157 (0.0122) Ages ≥ 85: -0.0142 (0.0084) Log Mean: 0.0007 (0.0077)	
		Peak CO 1960-1969, All locations Ages 15-44: 0.0679 (0.0441) Ages 45-64: 0.0772 (0.0405) Ages 65-74: 0.0059 (0.0173) Ages 75-84: -0.0085 (0.0213) Ages ≥ 85: -0.0158 (0.0162) Log Mean: 0.0162 (0.0149)	

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Lipfert et al. (2006, 088218)	Mortality Health Outcome (ICD9): Nonaccidental Study Design: Cohort Study Population: ~70,000 hypertensive male U.S. veterans Statistical Analyses: Cox proportional-hazards model Age Groups Analyzed: NR	Pollutant: CO Averaging Time: 95th Percentile Annual avg Mean (SD) unit: 1976-1981: 7.6 (2.9) ppm 1982-1988: 3.4 (9.5) ppm 1989-1996: 2.4 (0.67) ppm 1997-2001: 1.6 (5.6) ppm Range (Min, Max): NR Copollutants correlation: ln(VKTA): r = -0.06 Avg NO ₂ : r = 0.43 Peak O ₃ : r = 0.08 Peak SO ₂ : r = -0.05 PM _{2.5} : r = 0.08 SO ₄ ²⁻ : r = -0.16	Increment: 2 ppm Relative risk (Lower CI, Upper CI): CO: 1.032 (0.954-1.117) CO, lnVKTA: 0.999 (0.923-1.081) CO, lnVKTA, NO ₂ : 1.012 (0.923-1.110) CO, lnVKTA, NO ₂ +O ₃ : 1.023 (0.939-1.115)
Author: Lipfert et al. (2006, 088756)	Mortality Health Outcome (ICD9): Nonaccidental Study Design: Cohort Study Population: ~18,000 hypertensive male U.S. veterans Statistical Analyses: Cox proportional-hazards model Age Groups Analyzed: NR	Pollutant: CO Averaging Time: 95th Percentile Annual avg Mean (SD) unit: 1999-2001: 1.63 (0.84) ppm 1999-2001 (STN sites only): 1.73 (0.77) Range (Min, Max): 1999-2001: (0.40, 6.7) 1999-2001 (STN sites only): (0.47, 4.2) Copollutants correlation: ln(traffic density): r = -0.199 PM _{2.5} : r = 0.040; As: r = 0.148 Cr: r = 0.448; Cu: r = 0.177 Fe: r = -0.138; Pb: r = 0.420 Mn: r = 0.357; Ni: r = 0.090 Se: r = -0.110; V: r = 0.230 Zn: r = 0.472; OC: r = 0.470 EC: r = 0.234; SO ₄ ²⁻ : r = -0.123 NO ₃ ⁻ : r = -0.088 PM _{2.5} comp.: r = 0.133 NO ₂ : r = 0.418 Peak O ₃ : r = 0.172 Peak SO ₂ : r = 0.405	Increment: NR β coefficient (SE); t-statistic: -0.00000536 (0.0000324); -0.165
Author: Jerrett et al. (2003, 087380)	Mortality Health Outcome (ICD9): Cardiovascular; CHD; Cerebrovascular disease Study Design: Cohort Study Population: 65,893 postmenopausal women without previous CVD Statistical Analyses: Cox proportional-hazards model Age Groups Analyzed: ≥ 30 yr	Pollutant: CO Averaging Time: Annual avg Mean (SD) unit: 1.56 ppm Range (Min, Max): (0.19, 3.95) Copollutants correlation: Sulfates: r = -0.07 NO ₂ O ₃ SO ₂	Increment: 1 ppm Relative risk (Lower CI, Upper CI): CO: 0.98 (0.92-1.03) CO, Sulfates: 0.97 (0.92-1.03)

Study	Design	Concentrations	Effect Estimates (95% CI)
Author: Miller et al. (2007, 090130)	Mortality	Pollutant: CO	Increment: 1 ppm
Period of Study: 1994-1998	Health Outcome (ICD9): Cardiovascular; CHD; Cerebrovascular disease	Averaging Time: Annual avg	Hazard ratio (Lower CI, Upper CI):
Location: 36 U.S. cities	Study Design: Cohort Study Population: 65,893 postmenopausal women without previous CVD Statistical Analyses: Cox proportional-hazards model	Mean (SD) unit: NR Range (Min, Max): NR Copollutants: PM _{2.5} PM _{10-2.5} SO ₂ NO ₂ O ₃	All subjects CO: 1.0 (0.81-1.22) Only subjects with non-missing exposure data CO: 0.92 (0.71-1.21) CO, PM _{2.5} , PM _{10-2.5} , SO ₂ , NO ₂ , O ₃ : 0.93 (0.67, 1.30)
	Age Groups Analyzed: 50-79 yr		
Author: Pope et al. (2002, 024689)	Mortality	Pollutant: CO	The study presents results for CO graphically.
Period of Study: 1980-1998	Health Outcome (ICD9): Total (nonaccidental) (<800); lung cancer (162); cardiopulmonary (401-440, 460-519)	Averaging Time: 24-h avg	
Location: All 50 States, Washington DC, and Puerto Rico (ACS-CPS-II)	Study Design: Prospective cohort Statistical Analyses: Cox proportional hazards model	Mean (SD) unit: 1980: 1.7 (0.7) ppm 1982-1998: 1.1 (0.4) ppm Range (Min, Max): NR Copollutant: PM _{2.5} ; PM ₁₀ ; TSP; SO ₂ ; NO ₂ ; O ₃	
	Age Groups Analyzed: ≥ 30 yr		

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Note: Hyperlinks to the reference citations throughout this document will take you to the NCEA HERO database (Health and Environmental Research Online) at <http://epa.gov/hero>. HERO is a database of scientific literature used by U.S. EPA in the process of developing science assessments such as the Integrated Science Assessments (ISAs) and the Integrated Risk Information System (IRIS).

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